DOCUMENT RESUME

ED 421 916 HE 031 437

AUTHOR	Enghagen, Linda, K., Ed.
TITLE	Technology and Higher Education. The NEA Professional Library Higher Education Series.
INSTITUTION	National Education Association, Washington, DC.
PUB DATE	1997-03-00
NOTE	204p.; Many chapters based on the NEA conference, "The New Learning Environment, Servicing Diversity Through Technology" (Albuquerque, NM, 1994).
AVAILABLE FROM	NEA Professional Library, P.O. Box 509, West Haven, CT 06516-9904 (Stock No.: 2682-9-00-C4).
PUB TYPE	Books (010) -- Collected Works - Proceedings (021)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Access to Education; Collective Bargaining; Compliance (Legal); *Computer Uses in Education; Copyrights; Diversity (Student); *Educational Technology; Higher Education; Legal Problems; Legal Responsibility; *Technological Advancement
IDENTIFIERS	*Technophobia

ABSTRACT

This book presents 11 chapters on technology and higher education which are primarily derived from a 1994 conference on educational technology and diversity. Papers are grouped into three sections which address: first, technology, teaching and learning; second, the law and union contracts; and, third, technophobia. The papers and their authors are: (1) the keynote speech by Vice-President Albert Gore, "The Future of Technology and Education in America"; (2) "Moving Information Technology into the Classroom" (Steven W. Gilbert and Kenneth C. Green); (3) "Music Technology for the 21st Century" (Gene Aitken); (4) "Creating Accessible Education Through Technology: The Maine Experience" (Eric P. Healy); (5) "The Shrinking Pipeline Problem: Under-Representation of Women and Minorities in Technical Fields" (C. Dianne Martin); (6) "Creating a Future Scenario for Higher Education" (J. N. Musto); (7) "Copyright Law and the Information Superhighway" (Kenneth D. Salomon and Michael J. Pierce); (8) "New Frontiers for Copyright Law" (Linda K. Enghagen); (9) "Intellectual Property and Faculty Collective Bargaining: The Canadian Experience" (Donald C. Savage and Patricia A. Finn); (10) "Technophobia (Carol Baroudi and John Levine); (11) "Technophobia: Counterpoint" (Thomas E. Duston). (Individual papers contain references.) (DB)

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Linda Enghagen
Editor

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The NEA Professional Library
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Technology and Higher Education

Linda K. Enghagen, J.D.
Editor

Excellence in the Academy

AN NEA PROFESSIONAL LIBRARY PUBLICATION
National Education Association
Washington, D.C.

Cen 44227 A.

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Printing History
First Printing: March 1997

Note
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PREFACE

The 1994 National Education Association National Conference in Albuquerque provided the impetus for this work. The role of technology in higher education was a pervasive theme throughout conference presentations. In fact, many of the chapters in this volume are based on conference presentations.

Whatever our personal preferences, technology and the 21st century are quickly converging on higher education in the United States. Despite our individual preparedness and comfort level, the reality of this convergence is upon us. This original collection of works offers a variety of perspectives on various dimensions of this reality. Some of these pieces are personal essays. Others represent research on certain aspects of technology and higher education. Still others offer basic information on the practical aspects of understanding and managing technology in the higher education environment.

Whether you are a novice to it all or a master of the latest innovations, it's impossible to escape the presence of technology in education. This book reflects the multifaceted nature of technology and our relationships to it are intended to be reflected in this collection. On behalf of the authors, welcome to the future. Much of it is already here.

ACKNOWLEDGMENTS

We would like to express our thanks to many people who helped in the creation of this book: Kristine Anderson Dougherty, Research Associate, Bureau of Research and Data Analysis, Florida Department of Corrections who did the final preparation of the manuscript for publication; Christine Maitland and Rachel Hendrickson, NEA Office of Higher

Education, for assisting with the selection of topics and writers for the book; and, Professor Rodney Cole who shared his research collection in regard to Maine's foray into distance education. His generosity made Chapter 4 possible.

INTRODUCTION

Innovation in instructional, research, and administrative technology is not unique to the 1990s college or university campus. But no previous decade has required so many postsecondary faculty and staff to be so directly involved with new technologies in so many aspects of their daily work.

Computer and communications technologies were certainly a part of higher education in the 1960s, '70s and '80s. Faculty who are now retiring saw the development and use of televised or videotaped courses, mainframe computers, programming languages, computerized statistical analysis, computer-scored objective tests, and much more. These developments created some new academic departments, new organizational units like computer centers and campus television studios, and new positions such as computer technician and testing coordinator. Faculty in the 1990s, however, face increased expectations and demands:

- Computers are no longer housed in separate buildings. They're on many employees' desks and in many students' homes and dorm rooms.
- Distance education is no longer just a few courses on a public television station. The Western Governors Association is developing an entire "virtual University." Faculty is encouraged or pushed to offer courses on the Internet, on cable television stations, and over statewide or regional video communication networks. Internet resources, multimedia presentations, and desktop publishing are part of regular campus courses.
- Faculty and staff, in their administrative roles, use electronic mail, Internet resources, computerized student and personnel records, voice mail, and teleconferencing.
- With limited public funding, colleges and universities may see computer and communication products and distance education courses as potential moneymakers, and seek ownership of copyrights and patents for instructional and scholarly materials previously defined as the property of the faculty member.

These new technologies have come into academia just as financial resources are shrinking and (at least in some states) the number of students wanting a college education is rising. The students graduating from high school are also a more diverse population than in the past.

In that context, opportunities and challenges of new technologies can easily appear as threats to faculty academic freedom, compensation, authority, privacy, and professionalism. Among the concerns:

- State legislators, and college administrators seem to put scarce budget resources into poorly chosen, ineffective, or inefficient hardware, software, or communication systems—after failing to consult with the employees who would be asked to use the technology.
- Workloads are increasing, as faculty is asked to teach more students in more locations and to be more accessible through more communication modes.
- Faculty members perceive a loss of control over ownership and revenues from copyrights and patents on their work, including the re-use or use outside their own classroom of instructional materials without their knowledge or permission.
- At some institutions, threats to privacy and academic freedom have emerged through monitoring of E-mail and Internet access.
- At many institutions, there are little or no funds or time available for training in effective use of new technologies.
- There is a significant increase on some campuses in the use of part-time and contract employees to deliver instruction and other services through new technologies.
- Academic governance and departments at some institutions are experiencing a loss of control over the content of the curriculum and individual courses, as administrations purchase rights to distance learning or computerized courses originating at other institutions or private companies.

These concerns of faculty and staff led the National Education Association (NEA) to a set of actions to serve the needs of the over 80,000 NEA higher education members. One of these was a 1994 national conference, "The New Learning Environment, Servicing Diversity Through Technology," held in Albuquerque. Vice President Al Gore opened the conference as the key note speaker. College faculty, higher education and K-12 educational support personnel, and K-12 teachers met jointly and in their own constituency groups to

- learn about new technologies;
- consider Association strategies to aid other members in becoming technologically proficient;
- and discuss needed policy statements on protection of academic quality, academic freedom, and professionalism as new technologies are developed.

This book draws largely on the insights, knowledge, and perspectives of conference speakers and higher education faculty and staff attending the conference.

Leading off the volume, as he did the conference, Vice President Al Gore focuses our thoughts on the great opportunities of enhanced access to information and communication among scholars and the challenge of ensuring broad and equal access. If we can provide such access, he argues, "(t)he net result will be to elevate our ability to equip the children and adults seeking education in this nation as we have never been able to do it before."

But what will it take to not only connect colleges, universities, students, and staff to communications and computer technologies, but to move the technologies fully into instruction and enhance student learning? Steven Gilbert and Kenneth Green outline the obstacles to full integration of information technology. They also discuss strategies for institutions and faculty to implement effective applications of technology.

Other authors in Part One describe three case studies of the use of new technologies. Gene Aitken describes his department's award-winning approach to the integration of technology in music education. Eric Healy provides us with insights into the steps forward and the missteps as a state moves into development and use of a distance learning network. His description of the experiences at the University of Maine highlights the concerns of students and staff about academic quality. Dianne Martin shows us the elements of effective programs for bringing women and minorities into technology-rich academic disciplines and jobs. Wrapping up the section is J.N. Musto's creative and hopeful scenario for higher education in the future, drawing on the scenario building process used by the University of Hawaii Professional Assembly.

Part Two provides information about faculty and staff rights and responsibilities as new technologies transform the academy. Who owns a distance learning course? Can the university claim ownership and reuse your videotaped course or CD-ROM course unit without your permission—even if you know it has become outdated and inaccurate? How can digital material on the Internet legally be used in your scholarship and teaching? How can faculty unions, through collective bargaining, secure faculty control over courses and instructional and scholarly materials, thus preserving academic freedom and professional compensation? Those are some of the questions raised and considered here.

Kenneth Salomon and Michael Pierce, attorneys specializing in legal issues associated with copyrights, patents, and telecommunications, and Linda Enghagen, a faculty member with expertise in classroom issues, examine current law and the proposed National Information Infrastructure regulations on intellectual property. Canadian faculty, through collective bargaining initiatives spearheaded by the Canadian Association of University Teachers (CAUT), gained protections for faculty in copyright, patent, and technology transfer policies. Donald Savage and Patricia Finn describe CAUT's goals and strategies, and the outcomes in individual university policies.

Concluding the volume is a debate about faculty and staff attitudes toward technology. Are the "technophobic" in need of treatment and change? Or are they rightly suspicious and resistant to inefficient and ineffective uses of technology?

This volume will be of interest to many audiences. Policy makers considering budget allocations and campus policy statements will find insights into strategies for making good use of limited resources, while promoting student learning and employee effectiveness and morale. Faculty union and governance leaders will find essential information for employee advocacy efforts, including good collective bargaining agreement language. Administrators can find ideas that will help them encourage and enhance creative and effective use of technology on campus. We also hope that these articles will enhance faculty and staff understanding of the conditions under which they work and aid their efforts to make the best uses of technology in their classrooms, labs, and offices. Only with those efforts can faculty defend against technological threats to high quality teaching and scholarship, academic freedom, and supportive working environments.

This NEA Professional Library volume joins a number of other NEA resources for higher education employees interested in the implications of technology. Also available:

Information Technology: A Road to the Future? by Steven W. Gilbert and Kenneth C. Green. A guide to information technology issues in higher education, including the benefits and pitfalls of using technology in instruction.

Interactive Learning in the Higher Education Classroom, edited by Harvey C. Foyle. Discussion of interactive learning approaches that can stimulate student thinking, motivate student involvement, enhance student learning and problem-solving skills, and prepare students to work in groups and teams.

The Copyright Primer for Librarians and Educators, 2nd edition by Janis H. Bruwelheide. Jointly produced by NEA and the American Library Association. Explains what constitutes fair use, what doesn't, and what penalties/remedies are at stake for infringement. Includes information on classroom photocopying, off-air taping and videocassettes, distance education, the Internet, and multimedia products.

PART ONE

TECHNOLOGY, TEACHING AND LEARNING

1

THE FUTURE OF TECHNOLOGY AND EDUCATION IN AMERICA

by Albert Gore
Vice President of the United States

How can educators cope with the enormous explosion in the amount of raw information available? Vice President Gore argues that we won't be able to do it unless our current "two-lane roads" for networking computer resources are replaced with a true "information superhighway." Networks of new generation computers will give us the ability to locate relevant information and array it into usable patterns, but that won't help students and faculty who aren't connected to the networks. The Vice President asserts the importance of connecting all classrooms in schools, colleges, and universities to the information superhighway.

I'd like to speak to you about technology and education, and I'd like to start, not with expansive promises and far-ranging visions, but instead with a recognition of the fact that many in the field of education have, at times in the not-too-

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This article is based on Vice President Gore's remarks delivered to the 1994 National Education Association Higher Education Conference, April 8, 1994, Albuquerque, New Mexico.

distant past, gotten their hopes raised by the prospects of computers in classrooms and information technology as a way to enhance the productivity of education. These educators then found that the reality did not match the rhetoric and that the hopes that had been so raised were, in too many instances, dashed. There wasn't the software. There wasn't the teacher training. There wasn't the continuity of resources and instructional developments. There were all kinds of problems. The hardware was nice, but it didn't really make the instructional difference that people hoped.

I know there are many people reading this who went through that experience, who felt a little bit burned emotionally when reality did not meet expectations, and who are still a little bit reluctant to get back, once again, into the business of hoping that there is something to technology that can make a tremendous difference in their lives as professional educators.

I recently read a lament about the status of education:

> For more than 100 years, much complaint has been made of the unmethodical way in which schools are conducted. But it is only within the last 30 that any serious attempt has been made to find a remedy for this state of things. And with what result? Schools remain exactly as they were.

That assessment was made by John Amos Comenius in 1632 in a book called *The Great Didactica*. It is worth recalling that this kind of discussion has, in different ways, taken place before, and probably will take place again.

In 1632 the world was going through some interesting changes. Only 13 years before that, a young man named Rene Descartes, at the age of 23 on the banks of the Danube River, had a startling revelation based in part on the visual metaphors that came out of Copernicus' defining a new model for the solar system. Descartes' vision saw all the universe as being made up of dead, inanimate pieces of matter that moved in predictable patterns. Many historians say that, in that moment, what we call the "Scientific Revolution" really began.

Some 375 years later, we now see a new phase in the scientific revolution. In addition to inductive and deductive reasoning, we have a whole new branch of knowledge creation that the scientists are calling "computational science." One of my rules of thumb is, if you are talking about important things, and there are only two of them, if a third one is discovered, that's a big deal.

That is the case with computational science. Computers are now transforming the way we think about this world we live in. There has been an explosion of data. Information about everything is now available in much larger quantities than was ever dreamed possible only 30 years ago. Indeed, in some fields of knowledge, the total quantity of knowledge is doubling every eight months. Thus, the traditional approach to keeping up with a field of knowledge as a function of scholarship seems, to many people, no longer appropriate if the total sum of that knowledge is doubling in less than a year and the new knowledge is displacing some of the old.

The Library of Congress, I was told on a recent visit, now receives 10,000 periodicals a year from the nation of India alone. There is a surplus of data. Look at the delicate, indecipherable process by which data are turned into information, transformed into knowledge conveyed to the mind of another human being, and then, with luck and time, gradually fermented into wisdom. It is interesting to ask, what happens to that process when, at the front end, in the first step, there is suddenly an enormous explosion in the amount of raw data. Does this clog up the pipe? Does it create an intellectual contradiction: More data can result in less wisdom? One is tempted to hope, as we look at the problems we face around the world, that all the information we have available could solve these problems, if we could only figure out how to turn it into knowledge and convey it to others in the right way.

It has become obvious to more and more people that education, more than ever before, is the key to our future. It is also apparent that education and education professionals will have somewhat different roles to play in a world with such vast quantities of accessible raw information. Any teaching approach that relies on learning a multitude of facts in order to accumulate and disseminate knowledge is no longer acceptable in a world where all those facts become instantly available to students online.

So, many ask, "How can we cope with this new reality? What role can education play?" A friend of mine who works in the field of computational science once told me that if you tried to analyze and describe the human mind in terms that computer scientists use to describe the way the computer handles information, you could say that people have high resolution but a low bit rate. I asked him what that meant, and he said that if we tried to absorb information bit by bit by bit, we would not absorb it very rapidly. As an example, years ago the telephone company (back when there was one telephone company) did some studies and found out that seven digits was the most we could keep in short term memory.

The other half of his analogy—high resolution—is the hopeful part. That, my friend told me, means that if we see thousands or millions or billions of bits of information arrayed in a recognizable pattern, we can glance at it and absorb and understand all that information in one gulp. Clearly, part of our challenge in this new era of such vast amounts of information is to find better ways to mold information into patterns that we can recognize and gulp in large quantities.

The new generation of computers that are now coming off the manufacturing lines, unlike the ones that were tried so hopefully in classrooms in the 1970s, have so much more power to deal with large quantities of information that they can make a dramatic difference in our ability to do two things. First, we will have the ability to array large quantities of information into recognizable patterns. Second, we will have the ability to sort through large amounts of information to find the information "needle in the haystack", to find at a given moment information about *the* particular subject—*any* particular subject that interests us.

Now, here's the catch. These powerful machines that can make such a huge difference in our ability to navigate through all the information that is out there now cannot talk to each other. They cannot convey these information patterns from one place to another place unless the lines that connect them can handle the large amounts of information flowing through them. The phrase, "the information superhighway," is a simple analogy.

The little two-lane roads that criss-crossed America at the end of World War II became inadequate when Americans bought automobiles in large numbers. I remember when I was a young child riding back and forth from Carthage to Nashville, Tennessee. All of a sudden, Highway 70 would just clog bumper to bumper for almost 50 miles. Then the Interstates came in—superhighways to handle the big increase in the number of cars and trucks.

The current *information* highways that we have in our country were built for telephone conversations. Like Highway 70, they can't handle as much traffic (information) as is now flowing through them.

It makes sense to build networks of "information superhighways" that can convey large amounts of information and to make these networks accessible to the classroom. Our administration has called upon the industries involved, and set as a national goal the linking of every public school classroom in America to this information superhighway by the turn of the century. We believe that it can be done, and there are many hopeful signs that it *is* in the process of being done.

We know also that unless we take a new approach and greatly improve the access that educators have to the same tools that people in *other* professions are gaining or already have, our education system is going to be in trouble. Right now, only 22 percent of our classrooms have a telephone line. That means that more than *three-quarters* of our classrooms do not. We believe that *100 percent* of our classrooms should be hooked up.

The statistics about the challenges we face are well-known. The math scores of the top 1 percent of our high school seniors put them in the 50th percentile in Japan. Our dropout rate is 29 percent, compared to 9 percent in Germany and 6 percent in Japan. You know that has *got* to change. Of the 22 percent of our classrooms that have telephone lines, what percent do you think have modems? *Only 4 percent.* We cannot move into this new era of education when only 4 percent of our classrooms are able to take advantage of it. Our administration is committed to changing this situation and making sure this new technology is available.

I believe in my heart that, by the turn of the century, it will be possible for students in every classroom in the United States to plug into digital libraries, to plug into the Library of Congress, and to explore a whole universe of knowledge at their own pace, driven by their own curiosity. We are determined to make these advantages for American students available all over our country. We are also determined that this nation cannot and will not become a nation of information haves and have-nots. Access to the information superhighway and the educational enrichment it promises has to be available in rural areas, in poor areas, in every school.

The President has signed the Goals 2000 bill. There are aspects of this Goals 2000 package that fit in with this vision of the way we can give our schools the advantages of the national information infrastructure. The Goals 2000 measure is going to develop and adopt national performance standards aimed at improving teacher training, textbooks, instructional materials, and technologies.

We need to set standards that we can be proud of, that will enable us to have a population that is better educated than any population in the world and a workforce as educated and skilled as any on the face of this planet. That is why Goals 2000 doesn't have mandates. It has standards that educators and parents want to, and can, reach. To make sure these standards are reached, we are prepared to help with the new and innovative approaches with which many of you are experimenting. This information superhighway is going to break through traditional barriers by bringing resources and experts from around the world into classrooms, lecture halls, and laboratories. "Bring the world to the child" was the motto of a museum constructed in St. Louis 90 years ago because of the success of an exhibit at the World's Fair that offered a view of the university of the future. The idea of visual education and access to information about other parts of the world isn't new, but with E-mail, video conferencing, networking, and more powerful computers, the possibilities are much, much greater than ever before. The establishment of an Office of Educational Technology and the technology planning grants in the Goals 2000 Act are among the things that show our conviction that technology has a crucial role to play in the future of education.

Here are examples of how students, parents, and educators will both get and use this information. Educators can be linked to one another, ending isolation in the community of scholars. Just as it is crucial for students to be linked, educators also need networks to share common concerns and experiences, whether about curriculum, effective teaching techniques, or new discoveries in scholarship. One such network is the Department of Education's *Ask ERIC* Service. By sending educational questions through E-mail to *Ask ERIC*, educators can receive a response, either a direct answer or a list of further resources, within 48 hours. Are people using it? Are teachers using it? Does it help? *Absolutely.* Every week, more than 400 questions come in from educators around the country, and the information which *Ask ERIC* processes is immediately available online. Frequently-asked questions and answers are accessed more than 65,000 times a week.

There is another development in the information superhighway that took some people by surprise. The old saying, "There's strength in numbers," shows up in this network. People are finding that when lots of folks with personal computers and modems work together on the same problem, the results can be much more powerful than if all the work is done in one central location by a powerful computer or by a single group of people just looking at the problem in the same way. The intellectual cross-fertilization is an unexpected benefit.

I noticed an article in one of the science sections of the newspaper about a mathematical problem in the area of codes, where scientists had put together two giant prime numbers that could be multiplied together to serve as the basis of an unbreakable code. They confidently predicted that the most powerful computer likely to be created in the foreseeable future would take four quadrillion years to break through to the answer to that problem. As that got out on the information superhighway, people took it as a challenge. Somebody organized several thousand people with personal computers to break up the problem into small component parts and spread it around. Now they expect the answer in a few weeks—*four quadrillion years* ahead of schedule.

There's a lesson in that. There are two kinds of computers that they tell us about now. There's the kind that has the powerful central processing unit that sends out to the field of memory to get information, brings it back and works on it quickly, and then puts the answer back into the memory field. And then there's the new kind that they call parallel computers, or massively parallel computers. The difference, I'm told, is that instead of having one big powerful central processing unit, computational memory is broken up into many little processing units spread around through the field of memory, so that every place some of that information is stored, there is a small processor. When a big problem has to be solved, all of those little processors attack their little piece of the problem at the same time, and all the pieces of the answer are assembled very quickly. Instead of the very powerful unit having to go out and back so many times, all the units do just a little bit of processing and bring the answer together in the center.

When you stop and think about it, isn't that similar to what happens in democracy? You could say without too much of a stretch of the imagination that the reason the Soviet Union collapsed and the reason communism failed is that it was just impossible for all of those central planners to figure out what was going on out in every part of that empire and bring all that information back and make decisions. They didn't make good decisions because they *couldn't* make good decisions. They weren't close to the information they needed on which to base those decisions. When the pace of change sped up, they were completely overwhelmed.

Our nation began with the revolutionary principle that the average citizen, who was closest to the information about his or her life, was the person best capable of understanding what needed to be changed, what needed to be kept, and what decisions needed to be made about the future. When all of our citizens in this nation we love do that at the same time, and their verdicts are collected through free speech or at election time, then the answers, by and large, are much better as a basis for guiding the destiny of a nation than the decisions of some dictator trying to do everything there in the center.

Education has to work that way as well. You know that. You do that all the time. Now that we have these new technologies, we have got to spread them around, and we have got to make them accessible to every teacher in every classroom. The net result will be to elevate our ability to equip the children and adults seeking education in this nation as we have never been able to do it before. As an example, there's something called the Senior Net. It provides a forum for older Americans to help one another. I heard a story the other day that I think illustrates what the participants think about the benefits of the forum. A 93-year-old woman, whose family circumstances had changed, absolutely refused to enter a nursing home unless there was a line installed for her modem. Sometimes we think that only young people are comfortable with technology. Some people say that is one of the reasons why some educators have resisted technology. I don't believe it, although I have heard many times that a child is the only one who can stop 12:00 from flashing on the VCR. That's certainly true in my house. The truth is that telecommunications technology will benefit people of all ages, from 1 to 93 and older. In New Mexico, the La Plaza Telecommunity Foundation formed an online computer network in Taos County that is helping everybody of all ages in the community.

I have often been struck by a quotation at the Madison building of the Library of Congress, which is filled with research tools and fascinating exhibits. On the wall there is something that James Madison wrote: "What spectacle can be more edifying than that of liberty and learning; each leaning on the other for their mutual and surest support?" We must take advantage of the new opportunities in education that technology is now truly bringing. One of the single most hopeful signs I've seen in a long time is this gathering, this conference of educators who are dedicated to creating the kind of future that our country deserves, and I congratulate you for it.

2

MOVING INFORMATION TECHNOLOGY INTO THE CLASSROOM

Steven W. Gilbert and Kenneth C. Green

Colleges and universities are confronting the transformation of computers from personal desktop tools to communication gateways to information-rich networks. The authors argue that institutions must make continuing and significant investments in information technology resources. Why? Because these resources can enhance coursework and improve student learning, transforming student and faculty roles through the individualization of teaching. The authors discuss obstacles to the integration of information technology into institutions, visions (and nightmares) of institutions in the future, and strategies for faculty and campus adaptation to change.

> The pace of innovation in academe is perhaps best measured by the 25 years it took to get overhead projectors out of the bowling alley and into the classroom.
>
> —Unknown but Widely Quoted

The emergence of microcomputers in the late 1970s and early 1980s changed both the *uses of* computers and the kinds of people *using* computers. The first technology shift on college campuses—from mainframes and minicomputers to desktop systems—focused on computers and software as new tools for doing familiar tasks like word processing, financial planning, statistical analysis, and graphics.

Now colleges and universities confront a second phase of the "computer revolution in higher education"—a shift from computers as personal desktop tools to computers as communication gateways to information rich networks. This shift, along with institutional and national goals and investments in the "information superhighway," provides significant opportunities for higher education in the United States.

GREAT ASPIRATIONS

Film in the 1920s. Television in the 1950s. Computers in the 1980s. The education community has long harbored great hopes for the use of new technologies that might enhance learning. Nearly three decades ago Stanford professor Patrick Suppes, an early advocate of information technology in education, articulated a vision of an "information rich" learning environment in a *Scientific American* article that sounds current today:

> Both the processing and the uses of information are undergoing an unprecedented technological revolution. Not only are machines now able to deal with many kinds of information at high speed and in large quantities, but it is also possible to manipulate these quantities so as to benefit from them in new ways. This is perhaps nowhere truer than in the field of education. One can predict that in a few more years millions of schoolchildren will have access to what Philip of Macedon's son Alexander enjoyed as a royal prerogative: the services of a tutor as well-informed and as responsive as Aristotle.

Central to this vision is the interaction between *learning* and *information*, not just a simple link between *education* and *computing*. Computing and information technology can create a dynamic, interactive, and "information rich" learning environment—one not restricted by traditional boundaries of one college's classrooms and libraries. These resources can also make a technological approximation of a private tutorial system feasible, pressing us to question the value of the usual group classroom experience.

These new technologies have fueled great hopes on the part of many faculty and administrators and great investments in dollars and personnel on the part of institutions. But there is an underlying, often unrecognized dimension of this vision for information technology. It is a continuing challenge, that takes new forms in the presence of changing instructional issues, the demands of new kinds of students, and opportunities presented by new technologies. The effective use of IT requires a constant and continuing investment of human, financial, and technological resources. Consequently, IT is very different from the other kinds of physical resources (such as buildings and books) that are better known and understood in the financial models used by colleges and universities.

REVOLUTION OR EVOLUTION?

What can we learn from past experience? Looking back at the great proclamations of the mid-1980s, it is clear that the first phase of the "computer revolution in higher education" was *not* a sudden, massive revolution in either computing *or* technology. Rather, the emerging technology led to significant *evolutionary* shifts affecting instruction, productivity, information, and communication.

On the instructional side, the technologies introduced by the desktop computer in the 1980s created simulations and new tools for analysis that faculty could introduce to students in the classroom and incorporate into their teaching. Spreadsheets, word processing, drawing tools, statistical applications, and other tools provided a new and qualitatively different exposure to computing. Access to information technology was expanded to millions of students and faculty. Although most of these new users cannot write a single line of computer code, many are nonetheless highly skilled technicians, extremely dependent on their computers and related IT tools.

These tools increased productivity by helping faculty (and students) make better and more effective use of their time. Word processing became the center of a sea of change. With new technology *and* declining institutional resources, growing numbers of faculty turned to desktop computers, rather than departmental secretaries, to prepare course syllabi, exams, scholarly papers, and book manuscripts. The one-time investment in a computer, many administrators thought, was less expensive than the recurring costs of the secretary. And while computers presented new challenges for many faculties, the computer as a tool (financial analyst, graphics designer, word processing assistant) did not leave the office at 5:00 p.m.

Finally, the technology shift of the 1980s set in place the movement toward computer networks linking users with content from data libraries across the campus or across the country: census data, satellite photographs, financial databases, and more. Indeed, the access and integration of content found on networks becomes the third and probably the most significant component of the technology shift now underway.

These networks also have expanded and enhanced communication among faculty as teachers and scholars. Electronic mail circumvents "phone-tag," an all-too-often occurrence in a world of voice mail. E-mail and networks also expand the scope of dissemination of scholarly work. Informal distribution of photocopies to a small circle of colleagues has been replaced by digital distribution of draft papers on a disciplinary Internet mailing list. Digital distribution—via electronic journals, "in press" publications, and working papers—accelerates dissemination of new information.

While technology can serve as part of a process of transforming education, any prediction of a technological *revolution* in education will be wrong. You can stop worrying about waking up to discover a magical change. You can continue worrying (or being excited) about how you and your institution can most smoothly and successfully navigate continuing change.

Our friends in the information technology industries have convinced us that the next ten years will offer even more than the previous ten in educational applications of technology. The Internet, interactive multimedia, hypermedia, and groupware are already available as immature technologies with great potential for education. And those are the "old" technologies. Patterns of faculty and student use of teaching and learning materials are already shifting, and we are beginning to see irresistible opportunities for faculty use of technology. But there are currently no obvious means of providing the necessary space, equipment, software, and support services—the academic technology infrastructure—for deep and widespread integration of educational uses of information technology into undergraduate teaching and learning. There simply are not enough computers on college campuses today to support student and faculty needs.

In 1993 less than half of the faculty owned (or had possession of) computers. And faculty ownership (or possession) varies significantly by institutional type—highest in research universities and lowest in community colleges. Moreover, community colleges are more likely to place institutionally-owned computers in public access labs, classrooms, and clusters, while universities are more likely to place them in faculty offices (Green & Eastman 1993).

Other analyses suggest that the average time for personal computer use on institutionally-owned systems available to undergraduate students throughout the United States is only a few hours per week per student.[1] This is far short of the capacity that would be required if most courses included some student use of information technology. Student and faculty ownership offsets some of the demand, but does not satisfy all of it. Finally, as reported in the annual Desktop Computing Surveys conducted at the University of Southern California, the vast majority of colleges and universities have not developed budget plans or financial models that include continuing capital investment and operating expenditures adequate to support the frequent and routine use of information technology by individual students and individual faculty members (Green & Eastman 1993).

WHY INVEST IN IT?

There are several compelling reasons why colleges and universities must make continuing and significant investments to acquire and enhance the kinds and quality of IT resources available to students and faculty. They relate to competition, labor market preparation, the enhancement of curriculum and learning, and productivity.

Competitive Position

Growing numbers of college-bound students come to campus with computer skills and technology expectations. In 1993, 55 percent of all entering college freshmen reported having had at least a semester of "computer science" or some form of formal computing or technology instruction while in high school (Astin, et al. 1992). Consumer studies suggest that over 30 percent of American households now own a computer, and computer industry magazines report that over 40 percent of the computers sold in the United States in 1994 went into homes. While the variation in computer skills among students is striking, an increasing proportion of students come to the college campus expecting that the IT resources available at their institution will equal if not surpass those in their homes and high schools (Green & Eastman 1993).

College decision-makers also feel compelled to invest in computers and IT to assure potential students (and their parents and prospective employers) that the college provides IT resources comparable to those at peer institutions.

Labor Market Preparation

Technology skills will be essential in the labor market of the 21st Century. Higher education institutions would be doing a major disservice to their students if their programs failed to provide students—undergraduate and graduate, full-time and part-time—with appropriate opportunities to develop and enhance their IT skills.

Information access will be one of the key challenges confronting the growing cadre of knowledge workers and professionals in the 21st Century. One of the best and most compelling statements about technological or information literacy (or fluency) comes not from an occupational task force or industry group but from the American Library Association (1989):

> To be an information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information....Ultimately, information-literate people are those who have learned how to learn. They know how to learn because they know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them. They are people prepared for lifelong learning, because they can always find the information needed for any task or decision.

These challenges cut across academic disciplines and occupational and professional fields.

Curriculum and Learning Enhancement

IT can enhance individual classes, transform the curriculum, and improve student learning. However, IT cannot provide education in a vacuum. In the instructional context, IT "adds value" to the work of faculty, just as faculty "adds value" to the capacity of IT. Each enhances the potential of the other.

We believe that institutions need to consider the following questions:

- What can this institution do to enable students to learn better in person on campus than can be done through telecommunications or independently through technology?
- What can this institution do to enable students to learn better through telecommunications or independently through technology than can be done in face-to-face meetings on campus?

These questions are not mutually exclusive. Rather, segmenting the learning activities—those *better* (but not necessarily best) conducted in traditional classroom settings vs. those *better* (but necessarily best) conducted via technology—is emerging as a central task for higher education institutions and programs. Indeed, ignoring these questions will be more costly to the future of any institution than the largest conceivable investment in information technology.

But for teaching and learning, information technology alone cannot be the answer in higher education. As new confluences of epistemology, pedagogy, and technology emerge, combinations of books, shorter printed excerpts, and nonprint media from published information resources are more likely to provide the best support for college-level courses. And are getting easier for faculty to accept. The ability and commitment of the faculty to develop, select, and use new combinations of teaching materials and approaches are keys to making this transformation something worth working toward (Geoghegan 1994).

Productivity

Competitive, financial, and legislative pressures for quality and productivity are growing. The academic enterprise now confronts the same pressures that confront the corporate sector and a growing number of government agencies: *do more, do better, and do it for less.*[2]

Traditional models of productivity employed in manufacturing and other kinds of service organizations—more "output" for less cost—don't work well in the educational enterprise. Yet the external pressures to contain costs and increase productivity on colleges and universities will not subside. If the traditional models of productivity are not appropriate, higher education will have to develop compelling and cogent new models that have value and validity within and outside of the academy. Moreover, institutions, departments, and academic programs will have to invest in and integrate information technology to achieve significant gains on this issue.

Many higher education institutions have invested in information technology with the hope of achieving productivity gains. In almost every industry, "administrative" gains in productivity follow after a few years of integration of information technology. In some industries, much deeper change has resulted from using new technologies to alter some of the more fundamental tasks, products, or services. After even more years (in many cases, a decade) major productivity gains are achieved in conjunction with major shifts in the fundamental definition of the business.

Higher education is now experiencing some cost-savings and increased effectiveness resulting from the *administrative* applications of information technologies. However, there are few examples clearly documenting a link between information technology and academic productivity. More common are instances showing information technology to be no more expensive for delivering modest gains in learning fundamental skills or key concepts than traditional teaching.

Educational applications of information technology that improve the quality of learning and make it possible to teach more, better, and sooner are increasing in number and variety. But it is still too early to establish the cost reductions associated with these technology-based improvements in the *quality* of learning.

DEEPENING THE INTEGRATION OF TECHNOLOGY

Applications of information technology are being adapted and adopted by faculty members for different purposes and with different depths of integration and change. There is ample and impressive evidence documenting the ways that IT enhances individual classes and courses, affects the curriculum, and improves student learning. One of the best articles on this topic, written by Robert Kozma and Jerome Johnston (1991) at the University of Michigan, presents compelling evidence, drawn from a number of disciplines and a variety of campuses, about the role of IT as a catalyst for the qualitative enhancement of the learning experience. Kozma and Johnston identify seven ways that computing and IT transform the curriculum:

1. *From reception to engagement.*
2. *From the classroom to the real world.*
3. *From text to multiple representations.*

4. *From coverage to mastery.*
5. *From isolation to interconnection.*
6. *From products to process.*
7. *From mechanics to understanding in the laboratory.*

Listed below are a few examples, drawn from several disciplines:

- *Writing.* The best writing is based on frequent rewriting. Word processing takes the burden off the document preparation task so that students can focus on content.
- *Humanities.* A rich array of simulations plus textual and image databases are slowly but significantly transforming instruction in the humanities. Simulations can help students study logic, explore ethical problems from a range of perspectives, and "experience" the life choices of an 18th-century Frenchman. Textual databases, ranging from Greek and Roman literature through Shakespeare and beyond, allow students and scholars to explore content, context, and meaning in new and significantly different ways other than simply reading (and rereading) text. Annotated (often multimedia) resources bring new information and expand the meaning and understanding of texts and events in rich and engaging ways that no single faculty member, no matter how dedicated or well-prepared, could ever do.[1]
- *Social Sciences.* The growing availability of public domain statistical data from a variety of federal agencies (e.g., Census, Commerce, Health and Human Services, Education, Energy, NSF), coupled with the increasing sophistication of statistical packages now available for desktop computers, points to a fundamental shift in the way students can be taught statistics and should approach data analysis. In contrast to the way most campuses once taught statistics (emphasis on theory over analysis, small data files on artificial issues, proofs rather than meaning and explanation), we can now provide students with "real

world" data sets to do real analysis and test real hypotheses on real issues.

- *Science.* Computer-based algebra and calculus tutors provide an effective out-of-class instructional supplement for students. Computers allow students to simulate chemical and biological experiments that otherwise might require tens or hundreds of thousands of dollars in lab equipment.
- *Creative Arts.* Digital images and sound offer tremendous potential to students and faculty in the fine/creative arts. Multimedia resources such as Robert Winter's ***Beethoven's 9th Symphony*** and ***Stravinsky's Rites of Spring*** CDs (published by Voyager), bring new meaning and modes of instruction to both the general education class as well as to the student majoring in music. Digital manipulation of images opens new graphic and design tools to students in the creative arts.
- *Business and Management.* Census and Dept. of Commerce databases offer new resources for class projects. Simulations allow students to ask "what if" questions about financial planning and corporate management. Online databases from Dow-Jones and other commercial sources allow students to tap into the same databases and information resources routinely used in large corporations and small firms.

To this quick list we can add the growing array of resources available via the Internet. Disciplinary bulletin boards allow faculty who have never met to share a course syllabus or exchange information about textbooks and teaching resources. Students and faculty can join a disciplinary Internet mailing list and gain access to papers and other materials 6 to 18 months prior to publication. Public domain materials—statistical databases, satellite images, library catalogs, the daily press briefings and policy documents from the White House and federal agencies, and more—extend opportunities to access and use information well beyond the physical boundaries of the campus and library.

Presentation/Media

Some faculty members are effectively using technology to enhance presentations without otherwise changing the content or structure of the course. This includes using new search tools and reprographic technology to deliver course content on paper to students. Many faculty members are finding that using computer-driven devices for projecting visual images and sound enhances lectures and classroom presentations. For example, mathematicians are better able to create and show graphs of complex functions that enable many students to gain a more intuitive understanding of the underlying mathematical relationships. In art history, a lecturer can select and manipulate images to illustrate major points more effectively. In music, students are able to hear selections that have been chosen and manipulated by the professor to clarify certain patterns of composition.

Pedagogy

At a somewhat deeper level of integration, some faculty members are committed to new approaches to teaching that rely on technology for all or part of a course, altering the structure of the course and changing the modes of learning. Many of those who believe that the frequent exchange of work among students is essential for learning about the process of writing and for improving their skills in English composition have found computer networks and software valuable. Others are using electronic mail to change the nature of the interaction between themselves and their students and among the students. Many faculty members report that this practice enables more students to participate in "discussions" and that it increases the intellectual content and frequency of interaction between students and faculty. Students who are shy or have trouble with English are better able to participate when they have more time to formulate their thoughts and their questions. Not being dependent on scheduled office hours permits both students and faculty members to communicate with each other with less worry about disrupting each other's schedules and with more attention to substantive academic issues. Other faculty members have found or developed computer-based simulations to help students master "instructional bottlenecks" that have troubled students in previous years in the same course.

Content and Epistemology

But the most profound changes—the ones most significant and most difficult to reverse—result from new teaching goals for course structure and content based on new conceptualizations of the underlying disciplines.

Over the years, there have been shifts in epistemology—in the kinds of information that are accepted as knowledge—in many academic disciplines. Faculty members in a variety of disciplines are discovering that new technology applications permit them to represent and communicate information in ways that better reflect their changing views of knowledge in their fields. It is difficult to teach these new views using only conventional representations of information—print, pictures, and lecture.

Books organize information in a fixed, linear format. In traditional publishing processes, revising books is slow, difficult, and expensive work. Now, many faculty members are thinking of the knowledge base in their fields as dynamic and dependent upon the interaction of scholars, teachers, and learners, rather than as a stable "canon." In many fields, knowledge expands daily. Consequently, many faculty members are exploring the use of technology to represent knowledge that is not structured linearly and that must be updated or changed frequently.

In Geology, computer technology supports new forms of maps that are so different from two-dimensional paper representations that ways of thinking about the structure and composition of the earth are changing.

In American Literature, arguments continue about what should be included in the "canon," whether or not there should be any "canon" at all, and whether any single "edition" of a text is the only valid one. In this field, CD-ROMs and the Internet enable faculty and students to browse among and select from a changing array of writers and editions.

Not surprisingly, in Computer Science, courses are emerging in which most of the research and coursework is done via the Internet. In at least one course, the final assignment is for student teams to create new information that is made accessible on the Internet.

In Foreign Language, many now believe that learning a language cannot be effectively separated from experiencing the associated culture. Interactive multimedia is being used to convert that belief into appropriate learning opportunities, providing students with an electronic analog of the immersion experience of living in a foreign country.

In each of these cases, faculty members are able to provide students with combinations of printed material and information technology that convey new conceptualizations of the subjects.

Changing patterns in faculty preference of course materials at the level of media, pedagogy, and epistemology, have led publishers, bookstores, and faculty members themselves to select, assemble, and distribute in printed format "course packs"—collections of excerpts from books, periodicals, and other sources. A growing number of faculty members are now leading the way toward effective use of combinations of these print excerpts, along with books and new applications of information technology.

In sum, technology is only one element in an institution's approach to education. Long term, deep educational change must be driven by educational visions, not technological visions.

VISIONS OR NIGHTMARES?

What does the future hold? We can envision various end-states:

Nightmare I: Information Isolation (Not Likely)

The fears and ignorance of some academic leaders make them susceptible to visions like this one of the ultimate in cost-effective "information isolation." Most students and faculty spend most of their waking hours sitting at very comfortable, easy-to-use information work stations. Vast quantities of information are easily accessible and can be delivered in a variety of formats depending on the individual's perceptual preferences, abilities, and learning or research style. Students rarely meet in the same room with other students. The most highly paid "professors" are paid and treated—and perform—much like current TV news anchors.

Fortunately, this vision is highly unlikely for several reasons. First, it ignores some of the fundamentals of human nature. Most human beings need a social context for learning and prefer to participate in groups. Go talk with some young undergraduates and ask them about college. Ask them about the above scenario. Notice their reactions.

This vision also ignores the role of face-to-face contact in developing purpose, and the importance of purpose for learning. Versions of this vision are advocated primarily by those who mistakenly equate education with access to information alone.

Nightmare II: Elite Meet (Too likely.)

In this vision, 90 to 95 percent of all students experience the conditions in Nightmare I. The top 5 to 10 percent of students (in wealth, academic potential, or career potential), however, attend institutions much like present day small, highly selective, residential, four-year, liberal arts colleges. While there are many information work stations in dorms and at other locations on these campuses, students spend most of their time in small discussion groups and working face-to-face on collaborative projects with their peers and with faculty. Some faculty members can be observed working collaboratively with their peers, too. Most faculty are recognized both locally and nationally as accomplished scholars who have developed special skills in presenting information, leading discussions, and guiding the work of students and younger colleagues.

These faculty members have great latitude in organizing courses and selecting teaching and learning materials, but individual departments are responsible for articulating courses into a coherent whole. Other faculty members—those who are not on these campuses and who are involved in the instruction of the 90 to 95 percent majority of students through telecommunications—work within a highly structured system, developing materials that must meet detailed specifications.

In addition to learning to use their work stations for a variety of purposes—both scholarly and otherwise—the students on these elite campuses often work with printed paper materials, especially primary sources. While it has become common for people to use a variety of technologies to produce print-on-paper materials for entertainment and some other purposes, education is usually not among them. Most students who are not enrolled at the few, expensive, highly selective institutions rarely encounter works of such length, complexity, and coherence that reading print-on-paper is advantageous.

Unfortunately, this vision seems all too plausible. Maybe the percentages are wrong. Maybe, instead, the gap will be between the top 25 percent and the remaining 75 percent. Maybe the described distinction between the top 10 percent and the others will not be as extreme. But current financial and political pressures on colleges and universities are pushing toward a two-class educational system that is morally repugnant and could easily have disastrous societal consequences, undermining fundamental premises on which this country is founded.

A Vision Worth Working Toward

Here is a discussion draft of an educational vision.[4] It addresses some of the fundamental issues raised by the apparent possibilities for the more thorough integration of information technology into higher education: equity of access to information resources for students; the importance of face-to-face meetings and alternative communication via telecommunications; and the changing balance between individualization and standardization of teaching.

This vision places faculty and students at the center of courses, curricula, and community, seeking ideal combinations of content, pedagogy, and technology

Working individually, working with colleagues throughout the world who are committed to teaching similar courses, and working with members of their own departments in their home institutions, faculty members shape individual courses and build coherent curricula. They have the time, autonomy, and access to other resources necessary to sustain their commitment to a continuous process of designing and improving courses to fit:

- changing views of knowledge.
- changing student background, needs and abilities.
- changing ideas about teaching and about how people work in groups.
- changing applications of technology for representing and communicating information.
- changing abilities and interests of the individual faculty members themselves.

Departments and disciplinary associations accept responsibility for identifying—and revising when necessary—the core learning elements of course sequences most commonly taken by students.

All students who are eager and able to learn and willing to work at it have access to high quality education, including work stations, rich interactive electronic information resources, excellent books, and "custom-published" print materials. Many faculty members encourage or assign students the task of developing materials that will help others learn. Students are encouraged, guided, and helped to work collaboratively on challenging projects and to use the rich information resources available. In most courses, in addition to using the teaching/learning materials selected and assigned by the teacher, students learn how to find and use additional materials that meet their individual learning needs, abilities, preferences, and interests.

Educational uses of information technology are important but unobtrusive. It is easy for the faculty member(s) designing or modifying a course to find, develop, select, and acquire combinations of books, shorter printed excerpts, and non-print media from published information resources.

Effective economic relationships have been established between the publishers and distributors of the information resources, educational institutions, faculty, and individual students. Publishers and distributors receive net revenues adequate to sustain their continued investment in ever-improving educational materials for teaching and learning in higher education. Colleges and universities have reestablished stable economic support from a variety of sources adequate to sustain continued research and instruction.

Each student and each faculty member is able to have a sustaining experience—through both telecommunications and live contact—as part of an ongoing intellectual community where teaching and learning are central and human relations are nurtured and cherished. Communal activities are in balance with opportunities to pursue individual interests and to work in environments supportive of individual needs and abilities.

INDIVIDUAL IMPLEMENTATION STRATEGIES

Each faculty member needs a strategy for "classroom" uses of information technology. That strategy should be closely related to the mission and vision for the entire institution and to departmental and institutional strategies for instructional change.

Alternative Strategy 0: Cost-Benefit Analysi

This is the only one of these alternative strategies that just doesn't work. For the foreseeable future, there will simply be too many changes happening too fast to permit the kind of experiments, data collection, and analysis necessary for thorough, rational cost-benefit analysis. In most other industries, by the time it became possible to "prove" that some form of automation was really advantageous, most companies had already made the transition because it had become obvious.

More important, most serious efforts to integrate information technology into teaching and learning result in fundamental changes in the content of the course, the approach of the faculty member, and the experience of the students. It becomes impossible to compare the "before" and the "after" because the objectives are changed in the process. Only in a few instances are skills and content so fixed by such external criteria as certification exams that comparisons are easy.

Alternative Strategy 1: Extended Avoidance

Another strategy: Try to avoid using computers and related technology as long as possible. Eventually, some application of information technology will be recognized as fitting a certain situation or need so well that it will be too costly (in terms of time or other resources, but not necessarily money) or painful to proceed without the benefit of computing tools. For most individuals, word-processing has already reached this stage. Most people, once having tried word-processing, are willing to go to great lengths to use it whenever they must prepare written documents. Electronic mail may soon follow. Eventually, a wider range of educational applications will reach that stage.

Alternative Strategy 2: Peer Pressure

By identifying your peers (by discipline, type of institution, pedagogical orientation, etc.) and observing what they do, you can avoid some of the worst mistakes and avoid being left too far behind. Carefully pay attention to how others make use of educational applications. When at least 20 percent of your colleagues have committed to a certain technology or instructional application, then it is time to join in. This approach makes it almost certain that you won't be stuck with something that you will want to abandon only one year later. Having peers involved also means that there are good opportunities for sharing resources and ideas.

Alternative Strategy 3: Leader.

You can opt to be a leader with respect to technology and teaching and learning. It is very difficult to be a leader in the educational uses of information technology for more than a year or two without trying to be a leader in adopting new approaches to teaching and learning as well. One can't be sustained without the other. To be a leader in these dimensions means having substantial resources available—financial, philosophical, and infrastructural. Your students will probably benefit from the "Hawthorne Effect" of increasing the energy and enthusiasm of those who are engaging in new approaches. Other institutions and individuals should be grateful for what you are able to learn and share. But there is always the risk of failure, and you and your institution must be prepared to accept more than the usual number of failures if you embrace rapidly changing opportunities for using information technology.

OBSTACLES

What are the obstacles to full-scale academic integration of information technologies?

- *No Stability.* Unpredictable changes in the kinds of applications of information technology available for educational uses will continue for at least another ten years.
- *Mismatched Rates of Change.* New applications of information technology arrive in cycles measured in months. New experiments in approaches to teaching and new variations in textbook publishing arrive in cycles measured in years. New institutional structures for higher education arrive in cycles measured in decades or centuries. When attempting to negotiate new working relationships among these different sectors, it is important to acknowledge the differences in these cycles and learn to communicate across them.

- *Unrealistic Expectations.* Every few years a crisis of public confidence in education arouses some journalists and PR people from computer technology companies. If they find each other and neither of them has any experience as teachers or technologists, the result is another round of announcements that technology is about to totally transform education. A year or so later, about 10 percent of the educators and journalists and technologists are dismayed to discover that the revolution hasn't happened, and they blame the "Luddites"—the other 95 percent of the faculty. Early adopters, technology company "evangelists," and excited reporters can raise expectations too far, too fast. People who are disappointed by unmet claims become skeptical, even if the claims weren't made by those on campus responsible for new applications of information technology.
- *Faculty Attitude.* Faculty is central. Most faculty members are accustomed to knowing how to use the tools of their profession and to being treated like competent professionals. Faculty members can feel vulnerable, disempowered, and frustrated when confronted with new technologies that may not be easy to use or reliable. Over-worked support personnel who are experts in the use of the technology may not be the most patient or compassionate assistants to faculty members. A few bad experiences with equipment that doesn't work as expected or with impatient "assistants" can sour faculty on all technology.
- *Mismatches of Resources.* If there is insufficient knowledge of student-owned technology resources and insufficient coordination among faculty and technology resource managers, students can be caught in a bind. Enthusiastic faculty members may each separately assign the use of computers, for example, for required work in several courses and

then discover that many of their students have no convenient access to the necessary technology. Again, a few frustrating experiences can make both faculty and students less receptive to future opportunities.

TRENDS

Microcomputers, CD-ROMs, the Internet, authoring tools, multimedia, hypermedia, and virtual reality are only the beginning. Throughout the next 10-20 years, new applications of information technologies will offer ever greater potential for improving teaching and learning. We cannot yet predict with confidence when this onslaught of opportunity will slow down. Learning to ride these waves—instead of being swamped by them—is one of the most important challenges facing educational institutions and related industries today.

Books (primary source books and traditional textbooks) have both supported and structured much of the teaching and learning in past decades. As some of the new information technologies are added to form new combinations of instructional materials—textbooks, articles, computer software, Internet access, videocassettes—the processes of teaching and learning will be changed for those who use them. Conversely, efforts at curricular and pedagogical reform will fail if the basic tools of instruction—the books and the ways in which they are used—remain unchanged.

But "business as usual" is already finished. The patterns of faculty and student use of textbooks and other information resources have already begun an irreversible change. A strong indicator of change is the number of students who do not purchase textbooks in courses where the faculty member has adopted one. Other indicators include the growing number of faculty members who develop and use "course packs," and the increase in requests for the use of video media in conjunction with course assignments on many campuses. New means are needed for publishing, delivering, and helping faculty and students use new combinations of print and electronic materials successfully and cost-effectively. The long-term goal for all this change should be better learning at "reasonable" prices.

Many in the campus community—academic leaders, college store managers, publishers, information technology experts, librarians, and representatives of academic associations and professional disciplinary societies—see both problems and opportunities as new digital media compete for their attention and use. Many are more confused now than in the 1980s about which technologies and which media hold the greatest promise for education, and which will gain the commitment of the others. This is the right time to build more effective bridges among these groups. More communication, coordination, and collaboration is essential to support, improve, and extend teaching and learning.

Of course, having computers on campus is not the same as using the computers and related information technology resources effectively to enhance learning and educational outcomes. Indeed, the annual *Campus Computing* survey conducted by the Technology Teaching and Scholarship Project at the University of Southern California reveals that student access to institutionally-owned computers varies dramatically by type of campus. At research universities, only 20 or 30 percent of the institutionally-owned computers are available to students in campus labs and clusters, compared to upward of 70 percent at community colleges (Green & Eastman 1993, 8). The same survey reports significant variation across disciplines in the skills and ability of faculty to use information technology as a resource for instruction and as a tool in their scholarly work (Green & Eastman 1993, 31).

Information literacy involves far more than just being a competent computer user. Indeed, using the American Library Association (1989) definition, it is possible (and absolutely appropriate) to classify some computer techies as information illiterates. Alternatively, some faculty known for their Luddite-like aversion to computers for even mundane tasks such as word processing are nonetheless very information literate.

But in the closing years of the 20th century, information literacy has become clearly and firmly linked to information technology. In an earlier era the information infrastructure was built around libraries—sites that warehoused data resources and served users. The technology-driven information infrastructure of the 21st century is being constructed around networks—phone lines, cable wire and other connections that link individual users to digital repositories of information that might be ten, hundreds, or thousands of miles away. This new infrastructure depends on the computer as the gateway to new kinds of content (from full-text to multimedia) and growing numbers of "content providers" pushing products over phone lines, wireless networks, and cable-TV channels.

CAMPUS IMPLEMENTATION ISSUES

More than a decade into the "new computing in higher education" (Gilbert & Green 1994), campuses have learned much about the effective use of information technology resources in instruction. From this experience we can readily identify several issues that will affect the campus implementation efforts over the next few years.

Disabilities

No application of information technology is easier to justify on the basis of "cost-effectiveness" than that of enabling people with disabilities to function fully as faculty and students. The recent developments in the field of "adaptive computing" make it possible for those who have severe problems with sight, hearing, or movement to participate more fully in the teaching and learning process. The Americans with Disabilities Act adds a legal imperative to meet the needs of these individuals.

Each campus should develop a set of priorities and plans for using information technologies to help identify and meet the needs of those members of their community who have disabilities.

User Support

Lured in part by promises of "user friendly" software in the early days of the microcomputer, campuses and corporations have invested billions of dollars in desktop systems, campus networks, and software over the past decade. While the desktop systems do more, cost less, and are easier to use than the mainframes of an earlier era, user support and training remain a constant and costly component of the real costs of computing and information technology.

Who wants training and who needs support? Alas (and somewhat unfortunately), almost everyone—from the college freshman to the college president. Large numbers of students, faculty, administrators, and support staff still fall into the category of "new users." Rather than struggling for hours with a software manual or a tutorial, they would clearly prefer personal hands-on instruction and dial-up support service to help them through their initial experience (and frustrations) in the "flat part" of the learning curve. Still others, who view themselves as reasonably comfortable and competent with their current equipment and software, seek assistance using new (or upgraded) products. Finally, the rapid expansion of the Internet drives demand for training programs and user support services to help students, faculty, and staff master the intricate (and at times arcane) ways of the Web and Internet search and retrieval software.

In short, user support is a key and costly component of the information technology infrastructure. Yet some campuses have opted to cut support services because of general financial pressures. As new, increasingly attractive, educational applications of information technology continue to arrive, the need for training and support services will continue to grow. The day when the technology itself will be used in ways to supplement or replace user support services at the level where staff reductions will be acceptable is still in the distant future.

Productivity

The rising financial pressures confronting higher education over the past two years have led to increased public and campus discussion about using information technology to generate greater "productivity" in higher education. The stated hope is that the acquisition or integration of some new technologies into instruction will maintain or enhance student learning while reducing costs. The "technology yields instructional productivity" advocates are eager to demonstrate that information technology will either (a) allow the same number of faculty to "teach" more students at the current (or at an enhanced) level of learning or (b) allow campuses to serve the same number of students with fewer faculty and no loss in learning (either what is learned or the number of students who learn it). In both cases, the hope is that the costs of adding technology will be significantly less than the savings achieved by lowering faculty-per-student costs.

Technology can do much to enhance the learning experience and to improve instruction. But colleges and universities seeking the silver bullet for increased productivity and reduced costs should be wary of information technology advocates who claim great benefits and quick returns.

Capitalization and Amortization

Mindful that access to information resources and tools is important to both students and faculty, officials at many institutions still voice concern about costs—as they should. However, the common practice of treating the acquisition of microcomputers as a one-time purchase leads to increasing budgetary problems.[5] It is no longer a revelation to point out that the effective integration of information technology into any important process—including both administrative and educational applications on campus—requires a complex, continuing, and costly allocation of monetary and human resources.

The only sensible long-term approach is to develop and implement budgeting models that include support for the acquisition, maintenance, and replacement of hardware and software as well as the development and continuing availability of staff qualified to provide an array of training and technical support services. Each of these must be planned and sustained at a level consistent with the marketing and academic objectives of the institution and its ability to allocate funds in this area. A reasonable fear for many institutions is that their aspirations and resources cannot be brought into balance. That is one of the great challenges for college and university leaders.

But an even greater challenge is the one that questions the fundamental purpose and structure of colleges and universities.

Distance Learning

Information technology offers new ways to support new kinds of distance learning programs. Many of these options provide students with vastly more interactive communication with faculty than the old correspondence courses ever could. The "network" also provides distance learners with enhanced access to increasingly rich information resources. Most institutions and most faculty are still just beginning to understand how to use these new capabilities effectively and efficiently.

At the same time, some of the more advanced advocates of distance learning have recognized that the technological ability to serve students at some distance from their own campuses also makes it possible for new competitors to reach those same students. Colleges are beginning to find they are competing not only with more distant and dissimilar educational institutions, but also with commercial enterprises that may offer new forms of learning opportunities.

CONCLUSION

The *individualization of teaching*, a much less publicized transformation of the faculty role, has already begun. The term simply recognizes a significant increase in the motivation and ability of faculty members to select and use unique combinations of teaching materials. Just as no faculty member can offer one course that fits every student's needs, no textbook alone can fit every teacher's. Individual faculty members should, and increasingly can, find, develop, select, and use their own conceptual frameworks, teaching approaches, and teaching materials.

Three new trends make the individualization of teaching a more viable goal now than at any time in the past:

- Individual faculty members have new options available for finding and selecting combinations of a wide variety of teaching materials for use in a single course.
- Technologies available for reproducing and binding print materials have become less expensive, more accessible, and easier to use.
- The intellectual models associated with many academic disciplines are changing in ways that encourage faculty members to be more confident that they can and should make their own choices about the content of their courses.

If the individualization of teaching is a continuing (or accelerating) trend, it offers great challenges and opportunities.[6] The range and variety of teaching materials available is increasing faster than tools and resources for finding and evaluating them. The potential for faculty confusion is increasing faster than the potential for faculty assistance. Faculty needs help.

The Course Pack Plus Hypothesis is simply that the long-heralded and much-delayed integration of information technology into the curriculum will be based on a slow transition toward faculty adoption of combinations of print and non-print teaching materials.[7] This transition is closely related to the individualization of teaching. In particular, instead of an abrupt move from using only print to using only digital technologies, the vast majority of faculty will make a transition:

- From using only books toward using tailored combinations of smaller pieces of print (often in combination with books); and
- From using only print toward using tailored combinations of books, smaller pieces of print, and some non-print materials—such as computer software.

It is much more difficult for a faculty member to accept the prospect of completely replacing the use of print course materials with digital electronic ones than to think about adding one more element to an already familiar combination.

As faculty members further pursue options to individualize their teaching, more students are navigating their ways through multiple institutions over many years toward undergraduate degrees. In addition, more courses are being taught by part-time faculty, many of whom have relatively little contact with the colleges or the students. The power of a textbook *by itself* to dominate and structure courses nationwide is still strong, but waning. Consequently, the effort to develop and maintain well-articulated and coherent *sequences of courses* must be taken up somewhere, and the departments and disciplines seem the most likely candidates. The rapidly growing use of the Internet for intradisciplinary communication may facilitate these efforts.

Finally, how can faculty exercise greater control and make selections of course materials from a wider variety of options, when many institutions are increasing the teaching loads and other demands on faculty time? The effectiveness of both faculty and students can be improved by making it easier for the faculty to:

- Find information about teaching materials
- Make selections of teaching materials.
- Have their students obtain access to teaching materials (purchase or rent).
- Assemble, produce, sell, and deliver "course packs plus"—combinations of books, shorter-print documents, non-print materials (e.g., obtain copyright permissions and produce course packs in combination with software packages, Internet access, etc.).

NEXT STEP

You are invited to join the AAHESGIT electronic mailing list on the Internet to exchange information and improve teaching and learning through information resources and information technology.

The AAHESGIT list is used to exchange information in support of the improvement of teaching and learning through more effective uses of information resources and information technology. Participants' questions and contributions influence the direction and add to the substance of these Internet conversations. Steven W. Gilbert, Director of Technology Projects for the American Association for Higher Education (AAHE), is the moderator.

An electronic mailing list is a means of discussion through computer networks, most commonly now the Internet. Most Internet mailing lists enable individuals to attach their own electronic mail addresses to a common list. Every message sent to the electronic mail address associated with that list is sent to every electronic mail address on it. The *owner* of the "list" decides how people "subscribe" to it, how messages are handled, and other administrative matters. The *moderator*, reviews each message submitted before it is distributed to the full list.

The AAHESGIT list is heavily moderated. Only a few messages per day are distributed. Each one is introduced by a brief paragraph that identifies the length and author of the message and includes a very brief summary and, perhaps, a question for further discussion.

To subscribe, send your name and electronic mail address to Steven Gilbert (contact information below) and he will take care of it for you. If you prefer to subscribe yourself, send an electronic mail message:

SUBSCRIBE AAHESGIT YOURFIRSTNAME YOURLASTNAME
to LISTPROC@LIST.CREN.NET
For more information contact
Steven W. Gilbert, Director, Technology Projects, AAHE
Internet Address: GILBERT@CLARK.NET
Phone: (202) 293 6440 ext. 54
Fax: (202) 293 0073

NOTES

1 This estimate is based in part on the results available from Green's annual USC National Survey of Desktop Computing in Higher Education and on a calculation presented by William Geoghegan of IBM on May 11, 1994 at the annual meeting of the Higher Education Division of the Association of American Publishers in Boston, Massachusetts. The calculation was made with assumptions, whenever necessary at all, that were more optimistic than pessimistic about computer availability to students.

2 One West Coast university president echoed this theme—"do more with less, and do it better" in his 1991 inauguration address. It was intended as a statement about the financial pressures confronting higher education in general and his institution in particular. Yet not surprisingly, many faculty and staff in the audience had a strong negative reaction to this message. The new president was perceived as offering a very negative assessment on their current performance.

3 Examples here are the Aeneid and Columbus multimedia products developed with significant IBM support, Robert Winter's work on multimedia analysis of Beethoven and Stravinsky compositions, and some of the CD-ROM-based art gallery products now coming to market.

4 This vision statement was strongly influenced by an exchange of messages through the Internet mailing list "AAHESGIT" moderated by Steven W. Gilbert in the spring of 1994.

5 The 1993 Campus Computing report reveals that barely a fifth of the colleges and universities in the US have an amortization plan for their computer purchases.

6 The "individualization of teaching" to a greater extent will require more coordination within academic departments to ensure students can move comfortably from course to course as individual faculty members exercise their options more actively.

7 "Course pack" is a term referring to a collection of articles or excerpts from other publications that have been selected by a faculty member, for which any necessary copyright permissions have been obtained, and which have been reproduced and bound for the purpose of distribution to students as readings for that faculty member's course. Some people prefer the terms "course reader" or "course anthology." Many faculty members, even some who use course packs, are unfamiliar with the term. Among the best indicators of this trend may be the percentage of chapters assigned in textbooks that have been adopted for courses, the ratio of full books required to total courses offered, the percentage of courses in which some form of course pack or custom publishing is required, and usage levels of library reserve options.

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3

MUSIC TECHNOLOGY FOR THE 21ST CENTURY

by Gene Aitken

Computers and information technology—it's easy for us to see their applications in fields like science, engineering, and statistics. But, the author shows us, technology is also transforming music instruction on campuses. Focusing on the integration of technology into the total music curriculum at the University of Northern Colorado, he provides specific examples of computer hardware, software, multimedia products, and communication technology that provide unique experiences for students. The future of music education, he argues, will be shaped by increased collaboration in the production of materials, movement beyond "drill and practice" methods, and increased student access to performance instruction and practice through new communication technologies. The challenges: complicated legal issues in ownership of materials, and perpetual obsolescence of hardware and software.

THE CHANGING EDUCATIONAL ENVIRONMENT

Technology has the power to enhance traditional teaching techniques, provide for individual differences in learners, and advance new ideas and approaches to learning. The forms of technology being used currently in higher education vary considerably by institutional funding level and individual faculty initiative. In some schools there are enough computers for use by an entire classroom of students, while in others there is just one computer—or no computer available for classroom use. Some faculty teach students how to use the computers while others integrate the technology into their daily instructional activities. Still other instructors merge multimedia technologies like modems, laserdisc players, CD-ROMs, and CPUs with video capture boards for classroom presentations and student course materials.

Experts in educational tests and measurements (see for example, Bloom 1984 and Richter 1991) find that incorporating multimedia technology into teaching is akin to learning in a tutorial situation, especially if the technology is interactive. Text—a relatively *inefficient* way to learn—is also relatively *ineffective*. The learner retains only about 10 percent of the information. When lecture is added to text, the retention rate increases to 20 percent. By adding visual information like still photos or video, retention jumps to 50 percent. Finally, with the addition of interactivity to text, lecture, and visual material, the retention skyrockets to 90 percent. Other benefits: a nonthreatening environment for learners, the ability to review and replay instructional materials, and opportunities for self-testing knowledge of the material.

MUSIC TECHNOLOGY AT THE UNIVERSITY OF NORTHERN COLORADO

At UNC, we focus our attention on merging music technologies. Since there are no clear paths for integrating technology into the curriculum, the faculty incorporates technology in the classroom by both teaching and using the technology. As our dreams can far outpace the hardware or software we have at our fingertips, we find that with a little creativity and the involvement of our dedicated students and faculty, great things are possible.

The First Step—Enhancing Traditional Pedagogical Methods

Many instructors enhance their existing classroom lectures with simple computer-presentation programs that provide students with a visual version of material. This approach is an easy way for teachers to begin. Neither big changes nor too much of a commitment of resources are involved. Presentation programs can have a tremendous impact on both large and small classes. Students, statistical studies show, will retain more information if the instructors use visual aids. Instructor notes, outlines, flying text lines, *QuickTime* movies, and many other presentation ideas can bring technology into the classroom with a minimum of effort.

One of the premier presentation programs for classroom use is *Astound*, developed by Gold Disk, Inc. of Toronto, Canada. *Astound*, available on both IBM and Macintosh platforms, is one of the most user-friendly, inexpensive, powerful, and creative presentation programs available. The learning curve is easy and the auto-templates included with the program are quite good.

Astound and many other presentation programs allow the printing of outlines, slides, and notes so that they can be made available to the students. A quality presentation requires only a good overhead projector and the ability to project materials in color.

Other presentation programs such as *Persuasion* (Aldus) and *PowerPoint* (Microsoft) are very popular and provide instructors with a good choice of outstanding, easy-to-use programs. While authoring programs such as *HyperCard* and *MacroMedia Director* can be used as presentation programs, their learning curve tends to be quite steep. They are not recommended for the novice.

Another way to incorporate technology into traditional pedagogical methods is to help music students prepare their music theory, counterpoint, and composition assignments using music notation and sequencing programs—the 'word processors' of music.

At UNC, required classes such as Music Theory and Counterpoint previously accepted hand-written assignments. But unless the students were also pianists, they rarely heard their compositions, though music is an aural art. We now require students to turn in their homework, including both hard copy and a disk, using standard notation or sequencing programs such as *Finale* (Coda), *Overture* (Opcode), *MusicShop* (Opcode) and *Vision* (Opcode). Today, UNC students can hear their compositions and make necessary corrections before their assignments are due. Music Theory and Counterpoint instructors now embrace the use of the computer as a means of enhancing their students' learning.

In Keyboard Proficiency, rather than leaving the students to figure out what an assignment sounds like (since most cannot perform it), students use a sequencing program—*Performer* (Mark of the Unicorn)—to preview assigned exercises or pieces. Once these assignments are "played in" by one of the instructors, students can listen to the assignments and know how they should sound.

Using the sequencer, students can slow the assignments down and, without changing key, play along. If the students can't play both hands together, they can turn off the left or right hand, slow down the tempo, and play the missing part. With MIDI keyboards, the students can also select a musical sound of their choice, other than the piano. The results of teaching piano for both majors and non-majors are very exciting. Since this keyboard program has been implemented, instructors have found that students learn more material in much less time. And at the end of the term, student attitudes about their keyboard experiences are much more positive than teaching keyboard proficiency in the traditional way.

Using Current Software to Supplement Teaching

In the early use of mainframe computers, most computer use required writing programs in cumbersome languages such as FORTRAN and COBOL. Now, personal computer software is widely available and easy for novices to use. With software distributed on CD-ROM, one program can include a vast amount of text, graphics, audio, and video. More and more outstanding off-the-shelf applications geared to education are finding their way into classrooms on this medium. Companies have learned that the education marketplace alone is a billion-dollar plus industry and have made a wide variety of programs available for the Macintosh and/or IBM platforms for educators in almost every discipline.

The need for good, educationally sound, commercial software in music is as great as it is in any discipline. In music, students come to the university with varying backgrounds of musical experience. To bring all students to a minimum level of expertise, despite different levels of musical background, we encourage students to use many of the commercially available ear-training and music theory software programs. *Practica Musica* (Ars Nova), *Inner Hearing* (TAP), and *Claire* (Opcode) are only a few of the many music theory and ear-training programs that do well at repetitive exercises and, at the same time, provide immediate feedback as well as record the users' progress. These tutorial programs are helping many students to increase their level of musical proficiency rapidly.

Another creative commercial software program popular among music students and educators is a program called *Band-in-a-Box* (PG Music). Using MIDI technology, this program provides educators and students with a 'music minus one' jazz trio consisting of keyboard, bass, and drums. The power of the program is in the ability of the users to control the tempo, key, styles, and selection of the instruments, as well as input any chord progression of their choice. With no computer background whatsoever, a user can 'type' in any chord progression within a few minutes, including an introduction and ending...and even print out a lead sheet and chord progression.

Many commercial CD-ROM music programs are informative, creative, and easy to use. Considering the amount of content, usage-rights, design concepts, and development process costs, plus the cost of marketing and distribution, it is a wonder these programs can be purchased so inexpensively. From Voyager's Beethoven CD-ROM program in black and white, to the color of Microsoft's *Musical Instruments*, great strides have been made in design, navigation, content, and use of color. Although CD-ROMs can still be painfully slow with some computer hardware, the opportunity to incorporate non-linear learning and the exploration process far outweigh the lack of speed.

Another development applicable to both IBM and Macintosh platforms is an extension called *QuickTime*, that has helped make many of these CD-ROMs much more powerful. Using the *QuickTime* extension allows the user to play video clips recorded on CD-ROM disks. Depending on the power of one's computer and how the video was captured, a user can usually view anywhere from a one-quarter window at 10 frames per second to full-screen, full-motion video at 30 frames per second. Of course the larger the window and the faster the frame rate, the more computer memory is required. At this time, because of the amount of memory required and the lack of sophisticated compression, full-frame, full-motion color video on CD-ROM is not yet a reality for most students and faculty.

Although designed for teenage students, the new *Rock 'n Roll Your Own* (Compton's New Media) CD-ROM has a unique, attractive interface that will undoubtedly have an impact on the design of music education software. After users select a style of music from the menu, they can create a series of prerecorded beats, add prerecorded licks, and then record their own voice over the top of the song—and save their composition to cassette tape! This clever, creative, interactive approach will undoubtedly be used by other publishers, and extended to include other styles of music.

Finally, one of the most innovative commercial developments in music education is Coda's *Vivace*. This unique hardware unit, with an internal sound module, has the ability to follow, or accompany, almost any solo instrument (or solo voice) with a pre-recorded accompaniment. Coda is releasing many of the standard solo repertoire for beginning, intermediate, and advanced instrumental music students. Many of these have piano and/or orchestral accompaniment available. By using and/or attaching a microphone to almost any instrument, the hardware tracks the soloists' rhythm and pitch and 'follows' them at their tempo. In order to provide flexibility, an error correction is programmed in so that, should a soloist miss a few notes or rhythms, it will still follow. Soloists can also determine the percentage of control left to the hardware. At one extreme, the hardware follows soloists completely and at the other extreme, the hardware sets a strict tempo. However, one of *Vivace's* most powerful features allows soloists to slow down or increase the tempo without changing the pitch. In addition, soloists can change key centers if they wish an additional challenge or wish to perform the piece on another instrument or in another key. The popular Aebersold jazz play-along series has also been adapted to *Vivace* and can be used with the standard Aebersold play-along instruction books. In this case, the hardware control is set to lead, not follow.

Adapting Existing CDs And Videodiscs

Many educators are creating and designing materials with discipline-specific content, using the many audio and video CDs and laserdiscs that are currently available. At UNC, many outstanding programs have been developed using non-technical authoring programs such as *HyperCard* and MacroMedia *Director*. This use of music CDs or laserdiscs as part of a multimedia instructional presentation is referred to in the field as 'repurposing.'

Among the most popular software programs for 'repurposing' CDs and laserdiscs are the Voyager *Audio and Video Toolkits*. Using an authoring program such as *HyperCard* along with the Voyager *Toolkits* gives educators powerful interactive tools. Although several CD-ROM programs, such as Schubert's *Trout Quintet* and Britten's *Young Person's Guide to the Orchestra*, use these or similar tools, instructors can design and repurpose their own CDs or laserdiscs. And with the introduction of color *HyperCard 2.2*, it is now possible and fairly easy to design and create very sophisticated programs in color. *Hypercard 2.2*, however, is a "memory hog"!

Using *HyperCard* as a basic authoring program and an audio CD of their own choice, teachers can design and create a discipline-specific series of cards and then enter text information about the artists, historical details about each composition, stylistic considerations, and specific themes and compositional devices. Instructors can also have the music notation 'scroll' across the screen as the artist performs it.

Kyle Gregory, a doctoral student majoring in Trumpet Performance with a secondary emphasis in Jazz Pedagogy, developed one very interesting program. Using the Miles Davis CD, *Birth of the Cool*, Gregory repurposed it using many of these techniques. On opening the program, users can choose one of the compositions and learn about the techniques the soloists are using. Users actively participate in the listening process. Students can also listen and listen again to acquire certain listening skills. In several cases, the notation scrolls across the screen so users can not only see the notes, but see and hear the chord progressions.

Very similar to this program is another CD-ROM project developed by doctoral student Tom Strait, a Trumpet Performance major with a secondary emphasis in Jazz Pedagogy. Developed on an IBM-compatible 486, the program's objective is to teach a student how to 'lift' or transcribe a jazz solo. Using the authoring program *Toolbook*, students are taught the concept of transcribing step by step, including how to sing and memorize phrases. This concise program allows students to use CD-ROM, not for learning information about the recording, but to learn a related concept—the art of transcribing a jazz solo. Throughout the program, students are asked questions to determine if they are learning the information.

In the area of laserdisc repurposing, several unique programs have been designed using Pioneer laserdisc players and authoring programs such as *HyperCard* and/or MacroMedia *Director*. The commercial Pioneer laserdisc *Piano Legends* is a compilation of some of the finest jazz piano artist video clips available. With an informative narration by Chick Corea, doctoral student Kevin Murphy, Choral Conducting major with a secondary area in Jazz Pedagogy, designed this program using *HyperCard 2.2* with color XCMDs, to make an attractive, interactive, multimedia program. In addition to incorporating some of Chick Corea's narration, supplemental information on each artist has been added, including tips on what to listen for or to see when viewing the video clips. The video clips, some of them quite rare, make this one of the most popular programs the UNC Music Technology Center has developed. As no video capture board was used in the design, individuals using this program must use a Pioneer laserdisc player with a separate video monitor. If a RasterOps 24STV video capture board is installed in the computer, it is possible to play full-screen, full-motion video on the computer monitor.

Another excellent repurposing project, albeit quite different, was developed by Tracy Heavner, a doctoral student in Music Education with a secondary emphasis in Jazz Pedagogy. This program was designed using MacroMedia *Director*. When the program *Tenor Titans* opens, an attractive interface using still video frames, captured with a RasterOps 24STV board, pops up at specific places on the screen. Using *MacRecorder*, Heavner captured portions of the audio from the laserdisc to play behind the photos and titling. Once the index opens, users can go directly to the program or choose to learn how the program works. The hardware requirement of *Tenor Titans* is quite different than *Piano Legends*, in that users must have a RasterOps 24STV video capture card installed in their computer. When playing video segments approximately one-forth screen size, changing text accompanies the video as the artist performs. The program includes extensive information about the artists and their playing style in addition to a discography of the artists' well-known and available works.

Bar Code Technology

Although not considered repurposing per se, the use of bar code technology is another very popular way to incorporate audio CDs and laserdiscs in teaching. Much like the bar code technology used in the local supermarket, the hand-held Pioneer Bar Code Reader reads an instruction instead of a price. Inexpensive bar code technology allows instructors to locate and play segments on any CD or any CLV or CAV laserdisc, and to make the actual bar code on any Macintosh computer.

An excellent way to use bar code technology is to listen to or view the audio CD or laserdisc and decide which segments to use in any given presentation. Any segment of a CD can be identified by minute, second, and block. Any CAV laserdisc can be identified by frame number and any CLV laserdisc can be identified by time code in hours, minutes, and seconds. Location information on any of these media can be displayed on the computer screen or video monitor. When all segments have been identified, the Pioneer *Bar 'N Coder* software allows users to input all the segments at one time. Instructors can then print the bar code on almost any document or print the bar codes on Avery labels that instructors can then paste on their notes or in a text. The *Bar 'N Coder* software also allows for two printed lines of text, allowing instructors to identify both the laserdisc and the segment. Depending on the speed of the laserdisc player, any segment on any laserdisc can be located in from 0.5 seconds to 5.0 seconds.

Original and Semi-original Software

Many university music faculty want to develop software or hardware, but face the same issue: When will they have the time to devote to developing software in an already overloaded schedule? What are the incentives? And what are the rewards? Even with release time, unless grant money is available, there are usually no funds available to hire a replacement. One answer we've found is to work with graduate students and encourage them to develop programs. For their own future job prospects, it is useful for graduate students to be able to demonstrate projects they have developed. It also helps them learn the software programs.

For the past several years, UNC faculty in Educational Technology have been advising and working with many of our graduate music students in the design and development of original software programs. Our students enroll in Educational Technology classes, and by the year's end they have gained considerable expertise in content and design and can create informative, instructional, interactive, multimedia software.

One of the very first multimedia projects graduate students at UNC designed and developed was a videotape recorded by the great drum set artist, Mel Brown. As a former student of Philly Jo Jones, the master of brush artistry, Mel was in a position to hand down the lost art of jazz drumming using brushes. So, several years ago, he recorded a fifteen-minute video, Drum Brushes, to preserve an important element of jazz history. With Mel's permission, and using the now discontinued NEC PC VCR and the NEC *Multimedia Toolkit*, students were able to stripe time code after the fact on a copy of the videotape and then use *HyperCard* and *HyperCard* color XCMDs to build a simple, but interesting, interactive multimedia software program using videotape. Although locating certain segments was time consuming because of the slow speed of the tape transport, students and instructors began to see the potential of using video to enhance the students' education. This project was instrumental in giving us the vision to develop other programs.

One innovative program was developed and designed by doctoral student George Hess, majoring in Theory/Composition with a secondary emphasis in Jazz Pedagogy. This was a freshman ear-training program that was tested using control and experimental groups to try to determine if the computer could replace current classroom instruction in the area of ear-training. The program was divided into three categories: tutoring, practice sessions, and drills. Using *HyperCard* as the authoring program along with an off-the-shelf *HyperMIDI* application, the program specifically addressed atonal intervals, chord qualities (with and without identifying outside voices), and harmonic progressions. Since many freshman music theory programs throughout the United States include ear-training, we felt the results of this testing could have a significant impact on how ear-training is taught. The testing proved that computerized ear-training outside of class time produced essentially the same results as class time ear-training. In addition, the testing also proved that the computer program provided more consistent instruction and allowed students whose aural skills were not up to minimum standards to practice longer and to be able to review previously tried exercises in a friendly environment.

Another creative project was designed by Neal Finn, a doctoral student in Theory/Composition with a secondary emphasis in Jazz Pedagogy. Finn developed an interactive multimedia program, *Jazz Arranging*, from the ground up, including shooting and editing all the video, and recording a CD of his own music. After editing the videotape, Finn transferred the videotape to laserdisc. The users select any subject area in jazz arranging, from how to voice sax solos to how to plan arrangements. Finn's work includes excellent audio and video examples for the beginning to advanced arranger.

Another program, designed and developed by George Hess, is the *Great Sand Dunes* project, an informational kiosk that is now located in the newly remodeled Visitors Center at the Great Sand Dunes National Monument near Alamosa, Colorado.

This interactive video kiosk provides information about the culture, biology, and ecology of the Great Sand Dunes and the San Luis Valley. The program allows users to choose from among 13 topics ranging from Prehistoric Man and Native Americans to Plants and Wildlife or Theories of Formation. The program was created in MacroMedia *Director* and is presented on a Macintosh 660AV with CD-ROM and a Pioneer CLD-V220 laserdisc player. Materials were prepared using Adobe *Photoshop* and *Premiere*.

The program incorporates extensive existing materials, including historical and scenic still photographs, digital audio and video, and animation. The program was a cooperative venture between the UNC School of Music and Discovery Partnership, located in Colorado Springs, Colorado. Assisting in the authoring and development process was doctoral student Rich Macdonald, a Percussion Performance major with a secondary emphasis in Jazz Pedagogy. All the music for the program is original and was composed and performed by UNC students.

Another creative and different project provides music educators with a few ideas on how to make use of old but educationally sound videotapes. At a jazz convention several years ago, jazz artist David Liebman, who had recently marketed a video called *The Saxophone Sound*, was approached by UNC and asked about the possibility of converting this outstanding, educational, two-hour-plus videotape to laserdisc. The preservation of the integrity of the material, the design of the program, and the editing of the videotape down to one hour so it could fit on one side of a CLV laserdisc was under the able guidance of Rich Macdonald.

THE FUTURE OF MUSIC TECHNOLOGY

Collaboration

Technology in the area of collaboration is still immature, but should prove, in time, to be highly important and successful. In music, many educators are great teachers with a great deal of discipline-specific knowledge to share with the world. This is where collaborative possibilities exist. As computers increase in speed, we are going to be able to shift from information media such as paper, film, and videotape to computer-based simulations of those media. Libraries, newspapers, and books will not disappear, but their presence and significance in our culture will decrease and they may be used differently.

In the collaborative process of developing educational materials to be delivered by CD-ROMs and video servers, we can visualize a music teacher communicating online with a graphic artist or content specialist somewhere else in the world. The artist or specialist can see and hear the teacher, and the teacher can see and hear the artist and specialist. The information the teacher is working on is displayed on the computer monitor. The specialist and/or artist assists the teacher in designing a friendly interface that presents information in an informative and interesting way. Later, other specialists may be called upon to review the work being done—yet the teacher, the graphic artist and the content specialist have never left their office or homes.

Software today can turn a computer into a television, a CD player, or a telephone. The computer can transmit video images and music, snap photos, synthesize human speech, imitate a 16th-century harpsichord, organize databases and libraries full of books, and coordinate activities across space and time.

Beyond Drill and Practice

The computer program of the future should not just be a drill and practice mechanism. Connecting to vast networks in the classroom will allow students and teachers to collaborate on different projects in different states and different nations. Imagine a jazz band online, performing one of the many Latin compositions of Clare Fischer, Matt Harris, or any of the other gifted Jazz composers. Using the resources of an online communication tool such as the Internet, we soon will be able to contact a master teacher in Brazil or some other part of the world and play a sound or video of the composition in question. Immediately, we will get visual and audio feedback on the authentic way to interpret the specific styles and rhythms of the Latin composition from a master teacher.

There are other exciting possibilities. Now, to have master teachers at our universities, we have to fly them in, put them up in a motel, pick them up, and then take them back to the airport so they can return home. Three days of wasted time for a one or two hour master class. In the not too distant future, we'll have master teachers online, interacting with our students, hearing our students perform, and then providing the special insight that master teachers can provide.

Our society, not technology, will determine how this will occur in the future. Technology tools are socially constructed. If we think this master teacher concept is important and valuable, then it will happen. Society will see to that. At the same time, we must not forget that many of these tools are also shaped by tradition, politics, economic interest, history, and competing technologies.

The Performance Medium

Due to the decline of funding at the elementary, secondary, and university levels, we know that a reality check will soon be demanded at institutions of higher education, especially in the area of music. As funds in public education are reduced and arts programs are phased out, we find that public school district administrators are making reductions, especially in elementary school music staff. Eliminating music at this level will have a significant negative impact on music students at the junior high, high school, and college levels and in the adult life of many individuals.

The level of musical proficiency of the average music student entering the universities seems to be declining. Many less-popular or more difficult musical instruments—oboes, bassoons, trombones, horns, violas, and double basses—are vital to the traditional and contemporary music ensembles, but they are becoming less visible to young people.

By incorporating technology in the university classroom, it is still possible to graduate a student today who is equal or better in caliber to those of past years. Universities that are not incorporating technology will, in time, be at a decided disadvantage. The potential to use telecommunication via the Internet, while not giving us an answer to the traditional ensembles as we know them, may provide an opportunity for students to participate in a virtualization—participating in a small ensemble or studying music privately via the telecommunications network. This possibility is almost upon us.

Let's say a student is a member of a brass quintet. Rather than going to the school to rehearse, the students will 'meet' at a predetermined time in their own homes, dorm rooms, or practice rooms for a rehearsal, using their computers with attached video cameras and microphones. Each student's computer will display all five members of the group, no matter where they are. Each student will be able to see and hear the others in CD quality sound. And they will have an instructor or master teacher in attendance as a coach.

Another concept is that of teaching students musical instruments via telecommunications in the home. A student could not only take a lesson daily, but have an accompanist (such as Coda's *Vivace*), play with a band, and learn a musical instrument in a fraction of the time it now takes, and have fun doing it. If one thinks about it, taking 8 years to learn a few notes and rhythms on a musical instrument seems to be of questionable educational value. In the future, time, as well as immediacy, will be an even more valuable commodity.

The Cost Of Technology

Two by-products of the Information Age are: (1) greater efficiency and more opportunity than ever to incorporate technology in one's teaching and, (2) decreasing prices of teaching technology. According to Moore's Law (Intel Corporation CEO Gordon Moore), we will see double the performance of the technology at any given price level every 12-18 months. This means that whatever we are using now, in a little over a year, doubled power and capacity will be available for the same price.

Legal Issues Facing Universities

If university instructors or graduate students find the time to develop and create software and hardware, they may have to face issues that haven't been addressed by institutions or their faculty. What are the financial implications for instructors if software or hardware is developed using university equipment or developed on university time? Does a sabbatical leave to develop a project mean that the result of the instructors' work, if there is financial reward as a result of technological development, becomes university property? Do instructors market the product and perhaps give the university a piece of the action? Or does the university market it and share with the instructors? What about graduate students who don't own their equipment but who are required to write a dissertation? What happens if the dissertation committee approves a proposal that involves the development of computer hardware or software that becomes a commercial item? Does the institution demand its fair share?

As academic computing staffs find positions in institutions of higher education, they are increasingly realizing that the assignment and distribution of funds is not their only responsibility. There are many issues, legal and educational, facing the university. Not the least is the concern of universities that want ownership of every successful hardware and software innovation, especially if the instructor receives financial gain as a result of using school-owned equipment or developing products on university time.

Perpetual Obsolescence

Technology that is fast and powerful today will be passè tomorrow. As deregulation of the telecommunications industry make the phone, cable, and computer companies more competitive, we will see a decrease in the cost of having the latest in technology in our home and schools. Digital technology, the wave of the future, will change the way we work and live. It has already reshaped the business world and is making slow but significant headway into education.

According to Vice President Al Gore's article in this book, all schools will be on the Information Superhighway—not only those in Brentwood, but those in Watts as well. In order for this to happen and to exceed the four percent of schools who are currently online, additional taxes may have to be levied to ensure that every school has the essential services. If we think about this potential, we can already visualize a billion-dollar industry that will be created just to meet the needs of schools.

The government may be able to play an important part by coordinating the groundwork and promoting consensus among industries involved in setting standards for networking, switching, compression, and other technologies.

FINALE

Incorporating technology in the classroom today is fairly easy and inexpensive. Faculty can use it merely to enhance traditional pedagogical methods or to delegate repetitious tasks to the computer. At another level, technology may alter the way faculty teach as they make technology programs central to the instructional effort. In general, most of today's technology emphasis at the university level is based on integration rather than courseware creation. Tools for courseware development have very steep learning curves and, for the most part, musicians are not yet involved in this part of technology. Instructors view computers as instructional tools that can be used to enhance the classroom presentation or do the drill-and-practice routines that involve repetition. And instructors are just beginning to use sophisticated interactive simulations that will be the foundation of the high-tech classroom of the future.

With so much information available, music teachers have the responsibility to teach students how to learn and how to access information. We are in perhaps the most exciting period of education of any time. Technology promises to make students excited about learning and to make faculty enthusiastic about teaching.

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4

CREATING ACCESSIBLE EDUCATION THROUGH TECHNOLOGY: THE MAINE EXPERIENCE

by Eric P. Healy

Breaking down barriers to student access to postsecondary education—a common goal of state policy-makers as they invest heavily in distance education technology. The University of Maine system, the author shows, has provided significant funding for interactive television instruction, supported by capabilities for computer and audio conferencing, voice mail, electronic mail, and fax. But those investments have not been without controversy. Among the concerns of faculty and students: course quality, costs, system management, and technological "glitches."

INTRODUCTION

Computer and electronic technology permeates American society. Businesses possess abundant technological resources, ranging from networked computer systems and fax machines to cellular and video capabilities. Personal and home use of such resources has grown at unprecedented rates. The percentage of household PC users alone grew from

13.6 percent in 1985 to 36.4 percent in 1994 and is projected to increase to 60 percent by the year 2000 (Hinowitz 1994). At this level of technological growth, American educational institutions will also have to embrace these advances to meet (or exceed) the demands of a more technologically sophisticated populace.

Academic use of computer and electronic technology is not confined to classrooms and research laboratories. It extends to the use of interactive television (ITV) for instruction, breaking down physical and financial barriers found in traditional educational institutions. By employing computers, television, and fiber optic equipment, education in today's colleges and universities no longer impeded by restrictions in class size, staffing requirements, and physical infrastructure.

Technological advances have made educational institutions and their resources accessible to greater portions of the American population. Expert professors conduct classes that include student participants from across the country. Scarce university resources (such as library collections and research material) are shared with other institutions. The development and implementation of interactive technology is changing the delivery of education. This transformation is profoundly affecting traditional college and university frameworks. ITV technology, while offering many advantages, also challenges institutions of higher education to adopt new standards, policies, and procedures. Faculty, students, and staff at the University of Maine have faced these challenges since the creation of an interactive television network in 1989.

HISTORICAL OVERVIEW

Distance education—the use of satellite, videocassette, or telephone lines to link student and teacher—is growing nationwide. As early as 1991, distance education enrollment at the college level was estimated "to be in the high six figures nationwide" (Graham 1991, 1). The University of Maine entered the realm of distance education and interactive television technology to expand the state's delivery of educational programs and services. Much of the impetus for change came from the low percentage of the Maine population pursuing courses in higher education, the geographic and time barriers preventing many Maine residents from attending classes, and the continuing need to keep education affordable despite state budgetary constraints.

In the early 1970s, Maine responded to the need for accessible education by developing and implementing statewide community learning centers. This progressive move reduced the geographic barriers and travel time involved in attending college courses while providing greater course diversity for the state's ever-changing communities and work force.

By 1980, Maine's educational offerings lagged behind societal and work force demands. According to survey data from 1980, "people born in Maine made up 72 percent of our [the state's] labor force, yet Maine natives accounted for only 50 percent of those in the work force with bachelors degrees and only 39 percent of those with graduate degrees" (Connick and MacBrayne 1987, 23). Maine students favored occupations requiring little education or training, reinforcing the need for the continued development of new course offerings and changes in the ways in which they are delivered (Governor's Forum 1986).

In 1981, the University of Maine's Board of Trustees called for the creation of a community college system to serve the life-long learning needs of the state's residents. Maine had one of the lowest rates for high school students continuing on to higher education, as well as a low rate of adult continuing education (Beem 1992, 6). Policymakers and citizens, realizing that Maine was not effectively educating and training its residents for the demands of the state's future work force, quickly placed education among the state's list of most valuable and indispensable resources. But limited state budget resources and limitations in residents' geographic access to Maine's educational institutions worked against greater rates of college attendance.

According to Connick and MacBrayne (1987, 24), Maine ranked 41st nationally in state appropriations for higher education for 1986-1987. Faculty salaries in the University of Maine System also fell well below the national average for this same period (Hines 1987). Predictions that half of all current college faculty were expected to either retire or leave the teaching profession by 1995 proved even more troubling (*Lewiston Sun* 1986). Faculty recruitment to replace those leaving, however, remained only one of several hurdles for the state's educational administrators.

With only one third of Maine's population living within twelve miles of a university or vocational-technical campus, increased statewide participation in higher education was of paramount concern (Connick and MacBrayne 1987). Research underscored this need, documenting that physical proximity to educational institutions affects the rate of participation in higher education programs (Sullins and Atwell 1986). This is particularly true for Maine's adult population. Here, distances to educational facilities are finely balanced against commitments to work, family, and household.

Analysis of Maine's limited education resources led college and university administrators to a firm conclusion: "If we [the state of Maine and its educators] are to make better use of our limited resources and if we are to assure our rural area of equal access to high quality and diverse educational opportunities, we must devise better systems for distributing our [the educational institutions of the state] knowledge and information" (Connick and MacBrayne 1987, 24).

ACKNOWLEDGING THE NEED FOR CHANGE

In November 1985, the University of Maine System board of trustees charged Dr. George Connick, acting president of the University of Maine at Augusta, with the responsibility for drafting a proposal for "the development of a community college concept throughout the University System with particular attention towards policies and procedures governing access to the University for older, part-time and commuter students" (Connick and MacBrayne 1987, 25). By May 1986, Connick was authorized to undertake a second stage of planning incorporating strategic and futuristic implications of the proposal, as well as the need to best utilize existing educational resources.

Final recommendations included a commitment to move resources away from existing university system campuses. The plan called for the development of 10 new regional centers as well as the creation of 18 "extended sites" that would serve to "augment the existing campuses and off-campus centers of the University of Maine System." The proposal also recommended that local staff be hired to administer the proposed centers, while extended sites would be served by staff members at regional centers. Other key elements of the plan called for the establishment of a statewide testing and assessment program, a learning assistance program, and the development of course offerings based upon specific regional needs. Finally, the plan called for all university system locations to be connected by an interactive television network "designed to allow students and faculty to talk with one another while students observe faculty lectures from distant classrooms." The use of interactive television instruction would include all credit and community program courses offered by the university and its vocational-technical institutions as well as the possibility for future satellite linkage to all state high schools (Connick and MacBrayne 1987, 25).

Through the development plan, Maine would create an electronic information highway to distribute the state's educational resources effectively and efficiently. Proponents of the plan believed that "[a]pproximately eighty percent of the state's population would be within a twelve mile commute to educational programs and student support systems" (Connick and MacBrayne 1987, 25-26). Connick was also given responsibility for creating criteria committees to develop appropriate standards and policies for the plan. The Academic Council; the Task Force on Testing, Assessment and Evaluation; and the Task Force on Learning Assistance were formed. These committees elicited the opinions of numerous groups and individuals across the state. The goal: to determine the needs that could be met through the formation of a statewide community college and university network system.

On November 16, 1987, the University of Maine System Board of Trustees unanimously approved the proposal for the establishment of a statewide network that would combine "current telecommunications technology with the human resources of the University of Maine System to produce a comprehensive statewide network designed to make education more accessible to Maine people" (Education Network of Maine 1993). The University of Maine at Augusta (UMA) campus was selected as the foundation upon which the state's new adult-education system would be built.

Funding for the Proposed System

In 1988, the Maine State Legislature approved $2.2 million for the first-year funding of an Instructional Television Fixed Service (ITFS) system and its related network centers and sites. An additional $1.55 million was approved by the State Legislature for fiscal year 1990. Funding in the amount of $3.5 million for construction of a fiber optic network and other system components was received by UMA in the form of Federal Title III grants. Finally, a $300,000 grant from the Annenberg/CPB Project assisted in costs associated with improved instruction and support for distance learners through the creation of a Center for Distance Education at UMA (Education Network of Maine 1993).

The state of Maine, through its commitment to the use of technology, developed an entirely new means of delivering affordable education programs and services to its residents. "In fact," noted an observer, "the $7.3 million in state and federal funds needed to build the system is about what it cost the university to build a new dormitory at its Orono campus" (Graham 1991, 1).

The System and Its Technology

On September 5, 1989, the statewide system was inaugurated as the Community College of Maine. By 1992, the network was renamed the Education Network of Maine "to better reflect its ability to offer education at many levels from a range of education providers" (Education Network of Maine

1993). The system was developed by the University of Maine at Augusta (UMA) in consultation with the Technical College System of Maine, the Maine Maritime Academy, the Maine Public Broadcasting System, the Maine Department of Education, and New England Telephone. Consultation also included other college and university campuses that were engaged in the use of interactive technology or were contemplating doing so.

The interactive television network was designed and built by the Maine Public Broadcasting System and consisted of a three-channel audio and visual fiber optic spine, leased from New England Telephone, that connected to classrooms at each of the University of Maine System campuses. At each campus, the classroom signal is broadcast via ITFS (Instructional Television Fixed Service) from one transmitter to multiple receive antennae at the various receiving sites (Education Network of Maine 1993).

Students in remote interactive television classrooms receive instruction by a professor who is simultaneously teaching to a classroom of students on one of the University's larger campuses. The classroom setting is designed so that one video camera focuses on the professor, while another camera shows the instructor's use of visual aids. Both the instructor and any visual material are electronically transmitted to remote classroom sites where they are seen and/or heard by students watching television monitors. With the presence of an "audio talk-back" system in each remote classroom, students in distant locations are also able to interact with both the instructor and students at the originating classroom via dedicated phone lines.

While the Education Network of Maine primarily focuses upon the use of interactive technology, the system is supported by a host of other information technologies that allow students and faculty to communicate in and out of class (Education Network of Maine 1993). These include: computer conferencing (allowing students to communicate with professors about course issues), audio conferencing (allowing guests worldwide into the college classroom), voice mail, electronic mail, and facsimile capabilities.

Student Use of the System

The Education Network of Maine was specifically designed for the distant student. Its academic and student support services reflect this fact. At the time of this writing, a total of 93 sites comprised the Education Network of Maine. These facilities included 69 high schools, 11 centers, 6 vocational-technical schools, the 7 University of Maine campuses, and University College. Not included within this figure are non-published or "closed" network outlets that include the Maine State Prison System, Maine's Osram Division (formerly GTE), Central Maine Power, and the Bangor Mental Health Institute. In the Fall 1991 semester, 3,912 students registered for about 35 interactive television courses (Graham 1991). While about half of these were students pursuing two-year general-studies degrees, the system has been expanded to include both bachelor and graduate degree course work via ITV. In 1992, 67 fall semester courses were offered over the network. Course registrations for that semester totaled 5,641 (Education Network of Maine 1993).

According to more recent data, a total of 2,664 students, representing 5,041 ITV course registrations, studied for credit at a distance in the Fall 1993 semester. Of this figure, 81 percent were part-time. Roughly 45 percent of these students were non-degree candidates taking courses out of interest or to fulfill work-related requirements (Office of Enrollment Management and Student Services 1993). While it is anticipated that complete course offerings leading to both bachelor and graduate degrees will eventually be offered via ITV instruction, only students pursuing associate degrees are guaranteed that each of their degree course requirements will be offered over the interactive network. Bachelor and graduate degree candidates receive no such guarantees and primarily utilize ITV classes to fulfill general foundation course requirements.

Specific attention has been devoted to making academic, personal, and career guidance available to students of distance education. The Education Network's off-campus centers serve such functions for students taking courses via interactive television. These centers also "coordinate registration, academic advising, admissions, financial aid, counseling, and other services for students at the centers and at the high school sites in their region." This mode of academic, personal, and career guidance is supported by faculty and staff through the Center for Distance Education at UMA. This center "serves as a national model for development and traning in the educational uses of information technology."

All logistical matters surrounding students taking Education Network courses are handled by UMA's Office of Distance Education Technologies. This office is responsible for the copying, collating, and dissemination of all ITV course material. The Office of Distance Education Technologies controls all course syllabi, handouts, quizzes, and exams and maintains a video library of all ITV classes. The videotapes may be viewed by students who either miss a class or wish to review class lectures prior to examinations.

Student enrollment in interactive television courses is accomplished by one of two methods. The University of Maine at Augusta (UMA) is primarily responsible for all off-campus associate degree education. As a result, UMA selects both the courses and the faculty for all associate-level degree programs offered on The Education Network. All other campuses within the University of Maine System are permitted to staff and schedule their ITV courses through UMA's Office of Enrollment and Information Services. An Education Network Academic Advisory Council, consisting of members from each of the University of Maine System campuses, develops long-range course and program planning at all academic levels. Unlike live course offerings, ITV classes are not required to have a minimum number of participants. As a result, smaller communities are able to offer their residents a wider array of offerings without the threat of course cancellations due to insufficient enrollment.

Distance education students also have access to the University's computerized library catalog (URSUS) at all off-campus centers and ITV sites as well as at home through the use of a computer modem. The catalog lists all holdings of books, periodicals, and state and federal documents of the

University of Maine System. The computerized catalog also contains collections from both the Maine State Library and the Law and Legislative Reference Library at the State House. Additional computer searches may be made via the use of the Colorado Alliance of Research Libraries (CARL) or through INFOTRAC, a computerized index of academic, business, and health journals. Student users may electronically order library materials from the University of Maine System and have them sent to any specified location.

Student profiles of Education Network users in 1992 revealed that "it is Maine's rural women who make greatest use of the Network's services." Most students enrolled in Network courses are over the age of 30 (60 percent), female (74 percent), and travel an average distance of 11 miles to the ITV classroom, compared to an average trip of 31 miles to the nearest university campus. Surveys indicate that "the primary reasons students enroll continue to be the accessibility of course locations and the desire to complete or begin college degrees as a means of improving their employability." Academic performance of ITV students appears to mirror those of their on-campus peers (Education Network of Maine 1993).

Business and Organization Use Of the System

Maine businesses and organizations have begun to use the Education Network of Maine. This link between business and University of Maine resources can help foster economic growth throughout the state. Not only are Maine's employees and organization members taking courses over the Network but many businesses have come to use the system for teleconference services. One-way video and two-way conferencing are available statewide. While originating sites for teleconference services are limited to the Main University campuses, teleconference broadcasts may be received at over 100 sites statewide. Business use of the Network accounted for 700 hours of scheduled teleconferencing and special events programming in fiscal year 1992 (Education Network of Maine 1993). Further growth in this area is anticipated as an additional number of Maine businesses and organizations join the electronic information highway.

CRITIQUES AND OBJECTIONS

In 1992, the University of Maine System faced a $20 million reduction in its $153 million state appropriation. Given such enormous budgetary constraints, the university system administration and its trustees "tactically approved the substitution of televised classes for live classes in the name of economic necessity." While ITV received a substantial boost from such cut-backs, critics of the system wasted little time in calling into question both the cost and quality of ITV classes over that of live instruction. By February, 1992, members of the university system faculty publicly accused UMA and its trustees of using budgetary cuts to reduce "the quality of education through a massive substitution of television learning for live, in-class instruction" (Beem 1992, 6).

The number of live courses offered at the University of Maine at Augusta dropped from 375 in the fall of 1989 to 335 by the fall of 1992. In January, 1992, the University of Maine at Augusta administration attempted to persuade Board of Trustee members to replace 125 live course offerings with 40 ITV classes. Despite the flurry of opposing viewpoints, university system administrators insisted that the reduction was based upon statewide economic cut-backs and that without ITV classes fewer course selections would have been offered. By February, 1992, UMA administrators agreed, after considerable faculty pressure, that the number of live courses would only be reduced by 30. The cost of the ITV system, however, remained a focal point of heated debate. In 1992, break-even point figures for classes within the university system suggested that ITV classes were much more expensive to conduct than traditional course offerings. In fact, the break-even point for an ITV class was 87 students, a figure nearly 4 times higher than classes offering live instruction. Analysis of ITV cost estimates, however, revealed that ITV break-even points covered both capital costs and faculty salaries, while calculations for live course offerings only reflected money required to pay for course instructors (Beem 1992).

Notwithstanding, few are willing to argue that ITV is cheap to operate. The system commands a sizable portion of the state's education appropriations. Of the estimated $2.2 million in annual operating costs for 1992, $734,000 was allocated as debt service on the system's construction loans; $505,000 was in the form of salaries for 19 full-time and five part-time ITV employees; $505,000 was paid to New England Telephone for lease of the fiber optic cable that connects all ITV sites; $150,000 was issued to cover the lease of transmitter sites; $145,000 went for costs associated with ITV library services; and $129,000 for phone bills that are a part of interaction courses. An additional $408,000 (not allocated within the 1992 budget) was devoted to costs associated with faculty bonuses, overload compensation, replacement instructors, and stipends for teaching assistants (Beem 1992).

Proponents of the system argue that the costs associated with the ITV system are well-justified. Unlike traditional course instruction, the cost of the system remains fixed regardless of student enrollment. The greater the number of students placed within ITV classes, the lower the cost per pupil. This principle, proponents argue, keeps the ITV system in line with educators' goals of meeting budgetary constraints and offering affordable courses in higher education to as many of the state's residents as possible.

Concerns over the quality of education offered via the interactive television system has also fueled debate among both critics and supporters of the Education Network. UMA faculty typically encounter live class sizes of 20 students, while ITV classes average 115 students. It is not uncommon, however, to find ITV classes with 200-400 students per class. As faculty discontentment with the ITV system grows, the concern for quality remains in the forefront. Faculty routinely expressed frustration with the fact that ITV classes fail to offer students adequate personal and remedial attention. Some faculty members also argue that student interaction is limited throughout ITV courses and is impersonal at best (Cole 1993). Large class sizes also constrain the ways in which ITV classes are structured. This is especially true in the administration of tests, where many ITV instructors are forced to use multiple choice formats and machine scoring to administer exams efficiently. Another classroom constraint has focused on limitations in faculty ability to assign appropriate course work, given the large numbers of students. Many ITV instructors also decry the loss of academic control. The form and the content of their courses, they say, are dictated in order to make large class sizes manageable.

Students have also been vocal about the use of interactive television. Student support for the interactive system clearly grows in relationship to students' distance from more centralized university campuses. Those students affected by either geographic or time constraints are most supportive of ITV. These students are offered the ability to take ITV courses at remote ITV broadcast sites and are allowed greater flexibility in selecting scheduled times for courses.

Student opposition to ITV course instruction is equally compelling. Here, students are concerned with the quality of ITV instruction and its impact on the value of a university system degree. The perception of similarities to a generic correspondence school has gained popularity through media articles and student bantering that suggest UMA (and its ITV courses) is nothing more than "TVU" or television university. Technical difficulties with ITV classes have also frustrated many students. Blackouts are frequent experiences at many remote ITV sites because of equipment failures or storms. As a result, students in ITV sites are forced to sit idle until transmission is restored. Students must then later review videotapes of missed class segments or "down time" in order to complete an interrupted lecture.

Students, like faculty, cite concerns about cost, quality, and lack of appropriate system management as reasons for their opposition to ITV. In 1992, the student government at UMA threatened to invoke the Freedom of Information Act in an attempt to uncover the true costs of ITV instruction. The University responded, in the view of some, by overloading members of student government with often confusing cost information. Issues regarding class attendance, test monitoring, and the inability of instructors to effectively "gauge" ITV students' understanding of course and lecture material were among other student concerns. In the end, students remain split on the role of interactive television in Maine's institutions of higher education.

Much of the debate surrounding the use of ITV has been reduced to the issue of quality versus accessibility. On the one hand, sacrifices in course quality may be an undeniable concern for students enrolled in ITV classes. On the other hand, the mere existence of the ITV system allows a larger percentage of the Maine population to take courses in higher education. This issue was of such concern that a "Statement on Instructional Television" written on behalf of both faculty and student representatives was submitted to the UMA Board of Trustees. The statement noted that "there is an apparent wide-spread perception among faculty that the level of faculty governance deem[e]d generally appropriate for traditional classroom-based programs does not extend to programs that are delivered through instructional television. There is apparent ambiguity in student reactions to instructional television: on the one hand, a recognition that instructional television may reduce the cost for some of access to college-level course and program offerings, and on the other hand, a dissatisfaction among some students with the nature and quality of the learning experience occasioned by the technology" (Statement on Instructional Television 1991). A portion of faculty and student opposition can be attributed to a general discomfort associated with the implementation and use of modern technology by non-traditional users. Early start-up problems with the system also influenced many faculty and students.

SYSTEM SELF-DEFENSE

In September 1992, University of Maine Chancellor, Dr. Robert Woodbury, commissioned an outside team of educators to conduct a broad-based evaluation of the Education Network of Maine. The team consisted of Dr. Peter Smith, dean of the School of Education and Human Development, The George Washington University; Dr. Rebecca Corrie, chairperson of the Department of Arts at Bates College; and Dr. John Worthen, president of Ball State University in Muncie, Indiana. The reviewers were asked to assess "how well the Education Network of Maine has fulfilled its original goals, how well it adapted to changing circumstances since 1989, and what directions it should take in the future" (*Evaluation of the Education Network of Maine* 1992, 1).

The reviewers resoundingly concluded that "the University of Maine System is permanently and fundamentally changed in its potential to educate, its capacity, and its definition of what an education is" (*Evaluation of the Education Network of Maine* 1992, 5-6) The off-campus team praised the Education Network in the three broad areas of access, management, and quality. While the team recommended improvements in the coordinating of services, the development of more coherent management policy, and more systematic dissemination of public information, the system was well-received by the study team. The system, reviewers argued, has placed the state of Maine at a huge advantage when assessing its ability to meet future educational demands. The review team concluded by stating:

> We believe that Maine's future will be significantly different and better because of the decision to establish the Education Network of Maine. You have created a new infrastructure that is radically changing the state's real and perceived capacity to respond to the education, training, and communication needs of its citizens, government, and businesses. . . .You are among the leaders in the country with this combination of technology and community-based learning centers. We can only guess at the extraordinary long term potential for this system (6-7).

GROWING PAINS

Despite both continued praise and criticism, the ITV system faced numerous challenges in moving from its initial operational mode to a full-blown interactive educational system. With university system administrators supporting the expansion and further utilization of ITV, system growth would also prove problematic. Among the problems associated with the rapidly growing system were issues of faculty contracts, faculty job security, and concerns surrounding proper system administration and technological support.

University faculty wasted little time in suggesting to the Board of Trustees that a committee be formed to oversee the continued development of ITV instruction within the University of Maine System. In addition, Maine faculty called upon the board to create a written plan for future development of ITV. The proposed plan would elicit opinions from all University constituents, including faculty, students, and administrators. Specifically, university system faculty members expressed concerns about "the basis for paying faculty for offering televised courses...to ensure that faculty are adequately rewarded for the extra difficulty in preparing and presenting these courses" (*Statement on Instructional Television* 1991).

Faculty members also expressed concern that ITV would make course instruction redundant due to the fact that all ITV courses are videotaped. This, coupled with the system's ability to allow for greater class sizes, moved other faculty to believe that ITV instruction would eliminate the need for present levels of faculty within the system. As a result, faculty and their union leaders pressed administrators for revised contracts. This move commenced as early as 1988, when the Associated Faculties of the University of Maine (AFUM) prepared a written response to the Fall 1987 creation of ITV by university trustees. Along with the larger issues of cost, quality, and faculty participation in system planning, the AFUM report specifically called for control of course videotapes, funding for ITV course development costs and media training, and criteria for staff selection (AFUM Ad Hoc Committee Report 1988). Contractual language, it was argued, should also address faculty working conditions, evaluation, enrollment limitations, and intellectual property rights (Cole 1993). Many faculty members remain so polarized over the use of ITV instruction that they categorize their associates as being either ITV instructors (supporters) or non-ITV instructors (opponents).

Issues regarding the design and use of student survey questions and the relationship to Maine faculty conducting ITV courses was also of paramount concern. In 1989, AFUM alleged that the University violated Article X of the collective bargaining agreement when implementing an ITV student evaluation form (AFUM 1989). Faculty concern focused on the form being used not only to gauge the effectiveness of ITV courses and services with students but also to evaluate ITV faculty performance. In May 1991, a grievance decision required that "those sections of questions pertaining to faculty evaluation...are to be removed from the evaluation instrument (JX #10)...and may not be used in subsequent evaluations unless constructed in accordance with Article X" (AFUM 1989, 16).

Transmission glitches have also remained a source of contention among ITV users. While students were tolerant of such errors early on, there is a growing resentment among students who presently endure frequent transmission outages at remote ITV sites. Such resentment has prompted students to take a reactive stance against the administration. Student body organizations have heightened awareness of ITV courses through letter writing campaigns, open rallies, and direct appeals to members of the UMA board. A call for the codification of the conditions under which policies are created and management responsibilities are assigned is at the heart of much student and faculty debate.

Growth in the use of ITV courses has also affected the administration and governing bodies within the system. The general call for the integration of ITV courses within the university system has proved problematic. A 1993 Faculty Senate proposal called for the establishment of a standing committee on "Distance Education and Student and Community Services." This committee, one of six proposed standing committees, would "advise the President on issues effecting campus policies and priorities." Jurisdiction for the standing committees would be broad and include "any and all matters involving the University of Maine at Augusta not covered in collected bargaining agreements.[and] on any and all matters not traditionally/historically deemed the sole concern of any other delegate assembly without its permission/consent" (*Proposal For UMA University Senate* 1993). While this proposal conceptually sought to create committee involvement in addressing concerns posed by the ITV system, the proposal has since been "tabled."

THE MOVE TO SEPARATE THE SYSTEM

In a letter to the editor of the *Maine Times*, entitled "Not The Same" (1992), a full-time UMA student expressed her disappointment in the quality of educational course offerings via the ITV system. Her conclusion, based upon technical difficulties, inappropriate levels of student-teacher interaction, and the lackadaisical approaches of other ITV students, suggested that the ITV system be moved away from the community college level and used solely for University of Maine degree and professional courses. This sentiment has been echoed by many who argue that "the most successful [ITV] operations are involved in graduate programs, teacher recertification,...programs designed to upgrade professional skills and those that deal with highly motivated and skilled students" (Cole 1994, 5). A renewed effort to link ITV instruction and cable television has also made the education quality of such offerings suspect.

While ITV may provide a cost-effective and highly accessible means for offering mass education, its uses must be deeply rooted in academic rigor and policy-making. In May 1994, a series of preliminary recommendations were presented to the University of Maine Board of Trustees. The recommendations called for the separation of the Education Network from the University of Maine at Augusta. A proposed free-standing institution would be established that would both manage and operate the Education of Network of Maine and its services. The proposal called for the transfer of all off-campus centers, staff, support and library services, state marketing for distance education, and grant programs based on the use of information technologies away from the University of Maine. The new institution would effectively coordinate the transfer and dissemination of all university system technology and telecommunications functions while also accepting academic responsibility for a variety of tele-mediated educational programs, including those at the community college and high school levels (*Preliminary Recommendations To University Board of Trustees* 1994). On May 23, 1994, the board unanimously voted to make ITV and the Education Network of Maine autonomous. This vote also approved the allocation of part of the UMA budget and facilities to assist with such a separation.

THE FUTURE OF INTERACTIVE TELEVISION IN MAINE

In the words of former UMA President Dr. George Connick, "UMA has been able to grow because of the quality of its offerings and its ability to anticipate the educational needs of a new student population" (Connick 1993). While the development and implementation of interactive technology has progressively altered the ways in which traditional education is delivered, "various types of televised instruction are, no doubt, part of our national future" (Cole 1986, 1). This sentiment is echoed by the fact that American telecommunications companies are making financial commitments to interactive technology. Ameritech, for example, recently announced its plan to spend $4.4 billion in interactive video networks for use in homes, schools, libraries, and hospitals over the course of the next 15 years (Katz 1994).

Changes in student profiles and societal demands have also affected the ways in which education is being delivered in today's institutions of higher education. Traditional student models have long since been broken. No longer are four-year institutions the only prescribed course for those seeking serious forms of higher education. The vast majority of today's students "are part-time, commuter, and increasingly older." In addition, less than 50 percent of Maine's student population is actively seeking to fulfill degree requirements. Such changes force an awareness among educators that both educational institutions and their course offerings must be adaptable and ever-changing. The University of Maine "is a national leader in organizing to serve the new population of students." For Maine, this change has resulted in a move away from college and university centers. In 1973, for example, 75 percent of Maine's college students were on the Augusta campus. Today, students at Augusta represent fewer than 45 percent of the state's total college enrollment (Connick 1993, 2-3).

Maine's educational model embraces the use of modern technology in an attempt to provide high quality access to education while also expanding courses and programs to meet students' needs. The use of educational technology has fostered an increase in the level of academic and student services offered. The university system has also acknowledged the need to assist state businesses and organizations in making educational related information available to all. Without question, the University of Maine has committed itself to a formidable task. This task is further complicated in that the technology is almost limitless in its education delivery capabilities.

Maine is frequently cited as one of the pioneers in employing the uses of technology in education and is regarded as an educational system trailblazer by many. Its newly independent educational network will certainly have the capacity to surpass older interactive systems. In establishing such a new system, however, Maine must not fall victim to problems faced in earlier, more rough beginnings. Today's technology is arguably capable of delivering "education" to remote places of the world. Maine has committed itself to today's global information highway and, like many other institutions, struggling to determine how, when and where to the draw line. Information in today's technological environment is limitless. Deciding on what information to use and how to use it remains the true challenge for educators within the state.

Maine will undoubtedly continue to refine its use of interactive television technology as a means of delivering affordable, accessible, quality education. The University of Maine will likely establish partnerships with other academic and research institutions and will likely expand its student population to include residents from other states (or countries) and broadcast lectures (like that of Margaret Thatcher via the Global Lecture Series in September 1991). While administrative, management, and system delivery changes remain, the state of Maine has embarked upon a meaningful and rewarding journey, one from which many other institutions can learn. Perhaps the system's founder, Dr. George Connick (1993, 4), said it best in assessing Maine's model for creating education accessibility through the use of technology:

> UMA is no longer the small community college it once was. From humble beginnings as an outreach program at Cony High, it has grown to a major state educational resource. It has opened access to college in far corners of Maine and has given its people new connections to the world.

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5

THE SHRINKING PIPELINE PROBLEM: UNDER-REPRESENTATION OF WOMEN AND MINORITIES IN TECHNICAL FIELDS

by C. Dianne Martin

Both the cultural socialization of students and the characteristics of scientific and technical fields contribute to the under-representation of women and minorities in the technical fields that are becoming increasingly important as information technology evolves. The author identifies three methods of cultivating the interest of women and minorities in these fields: early exposure, attraction, and retention. A review of the characteristics of exemplary programs, the author argues, can be used to design programs that work.

INTRODUCTION

The work force for the year 2000 will require many more scientists, engineers, and computer professionals. New jobs that require a highly trained, technically competent work force are being created. Yet the engineering, science, and computing work force is aging, and there is a diminishing interest in scientific and technical fields among students in the traditional talent pool. The national imperative to educate science, engineering, and computing professionals is immediate and unconditional. An obvious solution to this dilemma is to recruit more students. But the traditional population source of white males is no longer adequate or dependable. Other sources for high quality professionals are minorities and women (AAUW 1991; Johnson 1990).

Women and minorities in the past have not pursued careers in science, engineering, and technology. Researchers describe this as the pipeline problem. The number of women and minorities shrinks dramatically at each level of education in these three areas. There are not enough female and minority students in the pipeline supplying the next level. While there are roughly equal numbers of boys and girls at the sophomore level in high school, only about 25 percent of males and 8 percent of females express an interest in natural science and engineering. After the first year of college, 50 percent of those males still have a preference for science and engineering, while less than a third of the girls continue to make that choice. The percentages continue to drop more rapidly for girls than boys at each educational level. The result? Although women make up 45 percent of the labor force, they make up only about 30 percent of the scientists, 20 percent of computer professionals, and 4 percent of engineers. And the percentages for minorities, both male and female, are even worse. Minorities (Black and Hispanic) constitute about 17 percent of the labor force, but only about 3 percent of scientists, computer professionals, and engineers (NSF 1988).

Researchers attribute the pipeline problem to complex social factors. These factors include the nature of the socialization process for young women and minority students and characteristics of the scientific and technical disciplines. Choices made by students and their ability to implement choices are influenced by these factors (Betz 1990).

REAL AND IMAGINED BARRIERS

Mathematics is a critical filter to career opportunities in scientific and technical fields. Underpreparation in math limits choices at each level of education (Berryman 1985). What are the barriers that keep women and minority students from continuing their studies in math and science? Preadolescent girls, studies demonstrate, are at least equal to boys in their aptitude for mathematical operations and concepts (Linn and Hyde 1989; Ethington 1988). During the early adolescent years, young women develop an explicit disinterest in mathematics and science. They perceive that interest in math is viewed as a boy thing and not socially acceptable for girls (Klein 1992). Minority students suffer from similar social pressures and view interest in math as a white or nerd thing. Minority students are also limited by school environments that leave them inadequately prepared in high school math and science. Deficits in prerequisite math and science courses become barriers preventing women and minority students from continuing college studies in science, engineering, or computing.

Socialization Factors

Some key socialization factors that influence female and minority student interest in scientific and technical fields include external expectations, self-confidence, self-efficacy, and prior computer experience.

The lack of encouragement toward science and computer careers by high school teachers and counselors steers female and minority students away from subsequent enrollment in college science, engineering, and computer courses. As a result of low external expectations, students tend to have low self-confidence in their math and science ability. Strong peer social pressure also discourages these students from showing interest or demonstrating ability in math or science.

Young minority women suffer from a double disadvantage. They typically do not have access to science or engineering activities or hobbies in their neighborhoods. Role models in science and engineering are rare. Parents often do not have a college education and do not see the need to support college attendance for their daughters. Limited family income, family responsibilities, and cultural values further limit their opportunities to pursue science and engineering careers (Edwards 1992).

The role of computers in influencing interest in scientific and technical fields is an interesting factor that has become significant within the last decade. Prior computer experience affects the sense of self-efficacy with computers for both girls (Bernstein 1992) and minority students. Since many college math, science, and engineering courses use computers, the lack of prior computer experience deters enrollment by female and minority students. Males have substantially more computer experience than females (Aman 1992). Boys are more likely to have completed computer courses in high school, used a greater variety of software, had greater access to school computing resources, had a computer at home, and gained computer experience in numerous other ways (Clarke 1992). Teachers expect that boys will do better in courses using computers. Their encouragement further reinforces gender stereotypes of computer aptitude (Culley 1988).

The Paradigm of Science

The invisible barriers separating women and minorities from scientific and technical fields do not stop with the socialization process of the teen years. Several studies suggest that the way science material is taught at the secondary and college levels is gender-biased (AAUW 1991). Most people perceive scientists as male, old, and white, wearing glasses, and working in a laboratory alone (Betz 1990). Science, as a discipline, encourages the stereotype of highly focused, almost obsessive behavior as the road to success. While males have been given license by society to be obsessive about careers, women are expected to be more "balanced." These views discourage females from choosing such fields.

Most college professors, when designing courses, problems, and lectures, think about the typical student as a white male. Female and minority undergraduate and graduate students in computer science lack role models, feel isolated, and have a reduced social support structure compared to their white male counterparts (Burton 1987). The courses taught in the first year, designed to cull rather than cultivate students for the discipline, affect female and minority students more adversely than white male students. Women and minorities are attracted to and learn better in a cooperative than in a competitive environment. The typical science and engineering curricula taught by predominantly male professors contribute to what Widnall (1988) describes as the "chilly classroom" for female and minority students.

The practice of separating mathematics, science, and computer studies from the humanities and social sciences at the secondary and college level is also unappealing to both women and minorities, both of whom tend to score highly on measures of social interest and concern. A study by Tobias (1990) also found that many students able to successfully complete studies in scientific and technical areas choose not to do so because of the perceived narrowness of those fields.

STRATEGIES FOR CHANGE

The fact that social attitudes become fixed during early teenage years suggests the efforts to influence young people's attitudes about future careers, personal abilities, and professional role models should begin before or during those years. Three areas need to be addressed to cultivate the interest of women and minorities in scientific and technical fields: early exposure, attraction, and retention.

Early Exposure

To increase early exposure to scientific and technical fields, parents, educators and policy-makers need to address the problems of racial and gender stereotyping, low expectations, limited access to computers, bias in counseling by teachers and parents, male-oriented toys and computer software geared to science, and the lack of role models in the media and in daily life. To counteract these obstacles, we need a national effort at the elementary level to develop programs in science and engineering that appeal to female and minority students.

Attraction

The major factors that need to be addressed to make science and engineering study more *attractive* to girls and minority students are parent and teacher expectations and advising and the male-oriented bias in the curriculum. Efforts should be concentrated at the middle school level where many students turn off to math and science. Attitude changes at this level can ensure that students choose a curricular track that provides the prerequisite academic background for the study of science, engineering, or computing. The focus on computers at this level should not be on programming, but on the relevance of the computer to social problems and the use of applications software in cooperative learning environments. Computers should be used throughout the curriculum, with equitable access for all children to provide a variety of computer experiences.

Other strategies should include the development of a national parent education program through the media and parent-teacher organizations and extensive inservice training for teachers and guidance counselors. We need to make people aware of their role in contributing to the pipeline problem. Industry can assist by providing role models in schools, developing gender-neutral software, and providing funding for special projects designed to attract young women and minorities to science, engineering, and computer careers.

Retention

Simply *attracting* women and minorities to begin studies in scientific and technical fields is not enough. Women and minorities are significantly more likely to drop out of science and engineering program. Retention in high school, college, and graduate science and engineering programs can be increased by several strategies. These include:

- the use of structured labs with group projects based upon cooperative learning models.
- formal peer, faculty, and alumni mentoring programs for women and minority students.
- pairing of college students with high school students and pairing of graduate students with college students to provide positive peer role models.
- guest lecture programs staffed by female and minority government and industry representatives to provide role models.
- computers available to students in their dorm rooms.
- more financial aid in the form of grants rather than loans.

Benefits from lessons presented in cooperative, rather than competitive settings are well-documented by research (Johnson, et al. 1981, 1983). Female and minority students have been shown to benefit particularly from cooperative learning environments (Johnson, et al. 1983). Cooperative learning has been used successfully at all levels of education, including the graduate level. This teaching strategy is characterized by positive goal interdependence of group members, individual accountability, heterogeneous groups, teacher observation and intervention when appropriate, instruction in collaborative skills, and group processing and debriefing at the conclusion of a lesson. Cooperative learning enables teachers to structure lessons that appeal to different learning styles and ability levels and thereby increase learning outcomes for all students (Johnson 1981).

Programs like these take a tremendous amount of time to develop and administer. So institutions should examine their criteria for tenure and promotion, rewarding faculty who develop new teaching strategies, develop innovative curricula, mentor students, and administer programs to meet the needs of special categories of students.

INTERVENTION PROGRAMS THAT WORK: A CASE STUDY

Carefully thought out intervention programs targeted to meet the needs of specific groups can make a difference at all levels of the pipeline. A number of exemplary programs have been developed to address these critical national issues. One such program, offered at George Washington (GW) University and funded by the National Science Foundation from 1989 through 1993, targeted the least represented group in scientific and technical fields—young minority women (Heller and Martin 1994). This program became the springboard for a conference of experts who examined and identified the characteristics of exemplary intervention programs. In this project, young women with aptitude were given the opportunity to use the latest computer technology to engage in scientific inquiry in cooperative teams under the guidance of computer science professionals and science teachers. These young women learned about both science and computers and came to view themselves as scientists.

Each year of the project, 24 minority female students from the 9th and 10th grades, plus 6 high school science teachers were selected from public and independent schools in the greater Washington, D.C. area. The project was based upon two ideas about students and teachers: (1) Female students with potential ability in the sciences can be motivated to prepare for the fields of computer science, engineering, or science by working together in cooperative teams to develop a science project using computer-based hypermedia technology and having exposure to role models in the field. (2) Similarly, by participating in a program that encourages high school science teachers to be facilitators, mentors, and researchers with a group of young women, teachers become more aware of specific strategies to encourage female students to prepare for the fields of computer science, engineering, and science.

The GW program had these objectives for the student participants:

- Allow young minority women to interact with female scientists and university professors as role models for potential future careers in science and engineering.

- Bring young minority women to a university setting to raise their sights toward higher education and to learn about the opportunities available to them.
- Develop in the greater Washington, D.C. area a peer network of young minority women who have similar interests in studying math, science, and engineering.
- Ugrade the skills and confidence level of young minority women in use of computers as a tool to conduct research.

The program had these objectives for the teacher participants:

- Upgrade the computer skills of the science teachers so that they could use computers as tools to enhance their roles as teachers.
- Provide the opportunity to develop a mentor/facilitator relationship with students demonstrating potential in math and science.
- Provide the opportunity to establish a collegial relationship with university faculty.

The project proceeded in four phases for each cohort:

1. Preparation and dissemination of solicitation materials and selection of participants.
2. A series of once-a-month Saturday science seminars that included computer instruction in a lab in the morning, a science speaker in the afternoon, and access to the computer lab every Saturday.
3. A ten-day residential program on campus at George Washington University.
4. A five-month follow-up program with Saturday computer labs and science speakers.

The cost of the project was about $2,000 for each teacher participant and $2,800 for each student participant. A formal evaluation of the first two years of the project was conducted by an outside consultant. This evaluation was based upon daily evaluations completed during the Saturday seminars and the residential program, questionnaires, and informal interviews with the participants. Results reveal that both students and teachers felt strongly that they had benefited from the project. The project directors, as part of the evaluation, continue to track student participants through high school and into college. Most participants are interested in going to college, many are interested in pursuing scientific or technical studies, and several each year have been accepted into highly competitive, prestigious universities.

Characteristics of Exemplary Intervention Programs

As a result of the success of the GW program, funding was provided by the National Science Foundation (NSF) to convene a working conference to study exemplary programs and determine how such programs can be expanded and institutionalized. In 1991, some 20 experts directing or working on programs to attract minorities and women to engineering and science participated in a two-day working conference at the IBM Decision Support Center (DSC) in Bethesda, Maryland. The panel was drawn from corporations, educational institutions, professional associations, foundations, government institutions, and volunteers.

The purpose of the working conference: to look at programs in general to determine the characteristics of exemplary programs and to investigate the possibilities of expanding the GW program beyond the NSF grant period. The conference examined what constitutes exemplary programs, how information about them can be disseminated, how such programs can be replicated to wider audiences, and what funding sources are available for such programs.

An IBM DSC Facilitator led the group through a series of exercises using the computerized tools available on the DSC system. Each participant sat in front of a computer and entered responses to a series of questions. Responses were sent anonymously and simultaneously to the system. The process was interactive. Participants could view their own answers as well as the answers of other participants and respond with additional ideas or information. The conferees were asked a series of questions about programs that attract women and minorities to engineering and science:

- What other programs are designed to attract young minority women to careers and studies in engineering and science?
- How do they differ from or complement the GW/NSF program?
- How can information about exemplary programs be disseminated?
- Can exemplary programs be replicated in other communities? If so, how?
- What are the criteria for success?
- What key partners need to be involved?
- What communities would make good replication sites?
- What are the financial needs of such programs?
- How can sources of financial and other resources be identified?.

The data entered about existing programs generated a list of 47 characteristics of existing programs. The characteristics ranged from participant selection criteria to spin-off activities. But the majority described the program environment. To determine the characteristics essential to exemplary programs, participants ranked the characteristics according to their importance, using a scale from 10 (essential), to 5 (important), to 1 (not important).

The first 23 characteristics, shown in Table 1, received a group mean score of 7 or more and were rated as the most essential characteristics for exemplary program. Participants rated follow-up after a program as the most important characteristic of an exemplary program, regardless of program design or setting. High expectations—a program atmosphere in which the program directors and participants expect the participants to be able to work hard and be successful in the program—was ranked second. A strong evaluation component, the ability to replicate the program at other sites, the involvement of teachers, and a teacher training component were also highly ranked.

Table 1: Ranked Characteristics from Exemplary Programs
(1 = not important; 10 = essential)

Ranking	Characteristic
9	1. follow-up
9	2. high expectations
9	3. role models
9	4. career counseling
9	5. fun
9	6. mentoring
9	7. parental involvement and training
8	8. partnerships
8	9. bridge program - precollege to college
8	10. cooperative learning environment
8	11. strong evaluation criteria
8	12. replicability
8	13. career oriented field visits
8	14. use of computers to enhance skills and confidence
8	15. teacher training for middle and high school teachers
7	16. student professional development
7	17. effective participant recruitment efforts
7	18. bridge activities for grades K - 12
7	19. focus on student interest and past experiences
7	20. community involvement
7	21. professional volunteer involvement
7	22. open-ended activities
7	23. real science
6	24. opportunities for student research
6	25. field trips
6	26. networking
6	27. curriculum relevancy
6	28. university faculty training
6	29. recognition of social barriers for minorities
6	30. structured lab activities
6	31. Saturday enrichment activities
6	32. after school enrichment programs
5	33. homework assistance/guidance
5	34. internship programs
5	35. student competitions, essays, fairs, olympiads
5	36. summer sessions
5	37. tutorials
5	38. library access
5	39. teacher/student teams
4	40. publications for students
4	41. stipend for participants
4	42. residential programs
4	43. apprenticeships
3	44. academics
3	45. lectures
2	46. vocational training
2	47. day at the mall

The list of ranked characteristics is important for program designers to consider as they plan new programs and enhance existing programs. These characteristics can be used as criteria by program reviewers and evaluators to select programs for replication or funding. However, the relative importance of the characteristics changes depending upon the lens used for ranking the characteristics. Conference participants ranked the 47 characteristics against four different criteria: the efficacy of a program from a middle school girl's point of view, the efficacy of a program from a high school girl's point of view, the likelihood that the program will result in the participants continuing on in science and engineering, and the ease with which a program could be expanded or replicated elsewhere.

Looking at programs from the point of view of a *middle school* girl, 11 characteristics ranked at 7.6 or above (Table 2). At the top of the list are fun, bridge activities, use of computers, and parental involvement. Looking at programs from the point of view of a *high school* girl, 22 characteristics ranked 7.3 or above (Table 3). At the top of that list are also found fun, bridge programs from precollege to college, and use of computers. Mentoring, role models, and high expectations were also highly ranked. Looking at programs from the point of view of the likelihood the girls would *continue on in science and engineering*, 23 characteristics ranked 7.3 or above (Table 4). Mentoring, bridge programs, high expectations, teacher training, follow-up, role models, career counseling, and parental involvement were the highest ranked. Finally, when looking at the characteristics using the criterion of *expanding or replicating the program elsewhere*, a list of 12 characteristics emerged with a rank of 7.3 or greater (Table 5). The list included such items as strong evaluation component, community involvement, parental involvement, high expectations, and partnerships with other organizations.

These features, combined with the suggestions on how best to disseminate and replicate good programs, can guide designers as they plan programs. Figure 1 illustrates a program planning and evaluation guide derived from the data. The guide includes demographic and descriptive data and a

Table 2: Characteristics From Exemplary Programs Ranked According to Importance for Middle School Girls.
(1 = not important; 10 = essential)

Ranking	Characteristic
9.5	1. fun
8.3	2. bridge activities for grades K - 12
8.3	3. use of computers to enhance skills and confidence
8.2	4. parental involvement and training
8.0	5. cooperative learning environment
8.0	6. role models
7.9	7. high expectations
7.8	8. mentoring
7.8	9. field trips
7.8	10. teacher training for middle and high school teachers
7.6	11. open-ended activities

Table 3: Characteristics From Exemplary Programs Ranked According to Importance for High School Girls.
(1 = not important; 10 = essential)

Ranking	Characteristic
9.3	1. fun
8.9	2. bridge program - precollege to college
8.8	3. use of computers to enhance skills and confidence
8.5	4. mentoring
8.5	5. role models
8.4	6. high expectations
8.3	7. teacher training for middle and high school teachers
8.2	8. career counseling
8.1	9. internship programs
8.0	10. networking
7.9	11. field trips
7.9	12. career oriented field trips
7.8	13. homework assistance and guidance
7.7	14. recognition of social barriers for minorities
7.7	15. focus on student interest and past experience
7.7	16. cooperative learning environment
7.6	17. open-ended activities
7.6	18. bridge activities for K - 12
7.5	19. parental involvement and training
7.5	20. real science
7.4	21. follow up
7.3	22. residential programs

Table 4: Characteristics From Exemplary Programs Ranked According to Importance for the Likelihood That Girls Would Continue in Science and Engineering
(1 = not important; 10 = essential)

Ranking	Characteristic
8.9	1. mentoring
8.7	2. bridge activities for K - 12
8.6	3. high expectations
8.6	4. teacher training for middle and high school teachers
8.5	5. follow-up
8.4	6. role models
8.4	7. career counseling
8.3	8. parental involvement and training
8.3	9. bridge activities for K - 12
8.2	10. internship programs
8.2	11. cooperative learning environment
8.1	12. fun
7.9	13. opportunities for student research
7.8	14. networking
7.8	15. partnerships
7.7	16. career oriented field trips
7.7	17. use of computers to enhance skills and confidence
7.6	18. real science
7.6	19. recognition of social barriers for minorities
7.5	20. curriculum relevancy
7.5	21. open-ended activities
7.5	22. community involvement
7.3	23. focus on student interest and past experience

Table 5: Characteristics From Exemplary Programs Ranked According to Importance for the Portability of the Program to Attract a Larger Audience
(1 = not important; 10 = essential)

Ranking	Characteristic
8.5	1. replicability
8.3	2. strong evaluation criteria
7.9	3. community involvement
7.8	4. parental involvement and training
7.8	5. high expectations
7.7	6. partnerships
7.6	7. career counseling
7.6	8. cooperative learning environment
7.5	9. bridge program - precollege to college
7.5	10. bridge activities for K - 12
7.4	11. effective participant recruitment
7.3	12. recognition of social barriers for minorities

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Figure 1: Program Planning and Evaluation Guide
Bringing Young Minority Women to Engineering and Science

Program Name: ______________________________

Program Site: ______________________________

Contact Person: ____________________ Phone: ____________

Program Format: After School___ Saturday___ Residential_____

Other(describe): ______________________________

Number of participants program can accommodate: ____ Age :___

How are participants recruited? ____________________

Ratio of applicants to acceptances into program: ____________

Drop-out rate: _______ Geographical extent of program: _______

Cost per participant to run program: ____________________

Cost charged to participant: ____________________

Funding sources: ______________________________

Partnerships or alliances created by program: ____________

Community involvement in program: ____________________

For any program targeted for minority girls, identify how the program provides:

1) Fun for participants
2) High expectation that participants will succeed in program
3) Bridge activity to next level of involvement in science and engineering
4) Mentoring
5) Role models
6) Cooperative learning environment
7) Field trips to labs, work environments, science museums
8) Parental involvement
9) Use of computers
10) Open-ended activities

In addition, for programs geared to high school girls, identify how the program provides:

1) College and career counseling
2) Internship opportunities
3) Student research opportunities
4) Opportunities to do "real science"
5) Development of a network and peer support group among participants
6) Recognition of social barriers that inhibit participation in programs / future careers

Plan for follow-up after program: ____________________

Plan for evaluating program: ________________________

Involvement of teachers or teacher training provided: ________

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checklist of characteristics necessary for an exemplary program. One feature of the guide is the list of additional characteristics needed for programs directed at high school girls, acknowledging their special needs. This guide can be used to gather data about existing programs and to plan new programs.

Many of the characteristics of programs that attract young minority women are also important for *all* female and minority students: positive counseling, role models, mentoring, esteem building, skill building, high expectations, hands-on activities, and involvement with actual experts in the field. A critical element to the success of any intervention program is consistent follow-up with participants as they make their way along the pipeline.

CONCLUSIONS

When examining underrepresented groups in the workforce, people often assume that the concerns and needs of specific constituencies are similar (Edwards 1992; Matyas and Malcolm 1991). Researchers and practitioners have shown that there is no single answer to the challenge of increasing the representation of minorities and women in science and engineering. Many different kinds of programs need to be developed, evaluated, and supported on a long term basis before this problem will be solved (Johnson 1990). Such programs must receive the support of government, school, community, and business leaders.

The small number of women and minority students choosing to prepare to enter scientific and technical fields is a major social issue that needs to be addressed at many different levels across society. In the pre-college years, programs must be developed and implemented that address socialization issues related to gender, race, role models, expectations, self-esteem, and self-efficacy. At the high school, college, and professional levels, science teachers and professionals must take a hard look at the unfriendly cultures of science, engineering, and computing as they now appear to these underrepresented populations.

A diversity of approaches to the study and practice of scientific and technical fields can be cultivated. A new paradigm for science—an integrated, more holistic approach—can increase the number of young women and minorities interested in science as a career. Such a paradigm should include greater attention to values, human issues, and social impact as well as the mathematical and theoretical foundations of scientific and technical fields. Using cooperative rather than competitive teaching techniques in high school and undergraduate science and technical courses can attract and retain a more diverse set of students and provide a richer, more stimulating learning environment for all students. These strategies , which enhance self esteem and confidence, maximize student learning rather than "gatekeeping" or culling students. They will be of particular benefit to minority and female students.

The lack of women and minorities in science and professional fields is a major social issue that needs to be addressed simultaneously by business, education, and government. Simply opening doors to once restricted career fields is not enough. The challenge is identifying programs that attract diverse populations to science and sustaining support for those programs. It is then up to all interested parties—policymakers, educators, science and engineering professionals, parents, and the students themselves—to support and participate in these exemplary programs. One of the greatest challenges facing the scientific and technical fields in the coming decade is the need to attract young women and minority students to 'enter the waters' and then provide a comfortable climate for them once they take the plunge.

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6

CREATING A FUTURE SCENARIO FOR HIGHER EDUCATION

by J. N. Musto

Scenarios for higher education cannot ignore the role of technology, says the author, executive director of the University of Hawaii Professional Assembly (UHPA). In 1992, UHPA, with NEA support, enlisted the help of the Global Business Network to construct four scenarios for the development of Hawaii's postsecondary education system. After describing the process of scenario development used by UHPA, the author presents an alternate scenario—"Technological Deliverance." A key element in the scenario is the development of an international consortium of faculty unions, which functions as an international "hiring hall" for faculty wanting to participate in SeaHawaii, a distance learning venture supported by regional cable companies. Faculty unions, in this scenario, have strengthened and become directly involved in planning for the future of higher education.

PLANNING FOR THE FUTURE

Technology cannot be ignored or undone. Like Pandora's Box, once opened the capacity of technological change is released—for good or evil depending upon your point of view. Scenarios for the future of higher education cannot honestly ignore technology. Institutions, academic disciplines, and teaching methods will be changed by technology. For the faculty, technology will be either an enemy or an ally. So what will this future be like?

It would be presumptuous for anyone to predict the future of higher education in the United States, let alone the world. Predictions are most often wrong, though they can have a "self-fulfilling prophecy" effect if they are strongly believed. Yet, questions about the future persist as we seek to at least *feel* some control over our destiny. In institutions of higher education as employment centers, faculty question the nature of the future realities of their work places. In the midst of "downsizing" from the lack of resources, state based initiatives directed at changing the workload of faculty bring new schemes for "accountability."

So, how can we intelligently discuss the future of higher education? Academics are daily engaged in variations on the "hypothesis-prediction" model; so why don't we just do research on the issue like any other subject? Do some systems work more effectively to help us capture the answers? Can we use planning tools developed for the private sector to look at this question? To some degree, the future is only the result of the component factors and choices made today. Yet more and more, the straight line concept of forecast predictions is being replaced by the observed realities captured in theories of complexity and chaos. The answers to our questions will come only from a dedicated, rigorous effort to explore the changes that are occurring. When we understand that the technology moving into our societies is not separate and apart from higher education, then we will be able to evaluate those changes in the context of our colleges and universities.

ONE APPROACH TO FINDING A FUTURE

In the spring of 1992, the University of Hawaii Professional Assembly (UHPA) embarked upon an endeavor that many persons thought was outside the "business" of a faculty union. At the invitation of Dr. Peter Arum, UHPA applied for a grant from the National Education Association (NEA) to support a project under the direction of the Global Business Network (GBN). The leaders of UHPA sensed that important changes were coming to the global society and that higher education could not escape the impact of those changes. To represent the interests of faculty and education required our organization to ask the question, "What is the future of higher education in Hawaii?"

GBN works, as its name would indicate, with businesses to describe the possible corporate futures in the private sector. Companies willingly pay substantial sums to those who can help them be better prepared for those futures. The GBN approach is that of the "futurists" who utilize the construction of scenarios in planning. Outcomes, results, and consequences can be expressed for private sector production of goods and services, but can you describe the aspects of a public sector, governmental activity such as education?

GBN's first efforts at working with public policy issues were in higher education. In a project sponsored by the California Faculty Association (CTA), another NEA affiliate, GBN led a diverse group of individuals in an examination of future funding for higher education in California. This project demonstrated that broad public policy issues could be understood through the use of the GBN scenario approach. Now, UHPA was interested in using this method as a way of raising a broader community interest in looking at the future of higher education in the context of the our local society. UHPA wanted people thinking about both the general role of higher education, and especially, the University of Hawaii's relationship to the state and its economy.

You build scenarios for the future by looking at the world around you today. The process of observation is the key. Futurists rely upon the delay between the understanding and knowledge of a few and the time it takes for the broader society to acquire these "new realities." If you clearly understand the array of options and alternatives present today, you can construct various "stories" that describe the possible futures within the next 10 to 20 years.

Under the direction of Dr. James Ogilvy, GBN came to Hawaii in the spring of 1992 to begin planning its approach. The initial work consisted of meetings and interviews with key individuals in the university, the government, and the private sector. From these interviews, Dr. Ogilvy would construct a picture of our "environment," and use that information to help clarify the questions that needed to be asked. This was followed by a period of examination of the information and data that was available concerning technological advances, the politics of Hawaii and the Pacific rim nations, the development of markets in Asia, the demographics of our island, and the expectations of our citizens for the university.

After the initial planning, a series of three all day workshops was convened, where Dr. Ogilvy and members of GBN joined with leaders of UHPA, faculty members, legislators, and persons from the private sector to begin the process of preparing to create scenarios that might describe the future of higher education. The single unifying factor among all of those who participated was their commitment to the importance of the university and their concern that the institution might suffer losses in the future if it did not make positive adaptations to change. All of the participants valued the university's role in our society, even if they didn't always understand it.

As the workshops proceeded, additional interviews of community leaders, university Regents, and other "key leaders" were conducted. Some of the questions and statements produced by the workshop participants were being tested in these interviews. The process was designed to build as much information as possible into the data base used to write the stories. Although scenarios are imaginative, they are not fantasies. They must contain an intellectually honest approach to facts upon which these stories are built.

One of the features in building scenarios, concerns the identification of "predetermined elements." A good deal of time was spent in the workshops identifying these elements and then testing them against both those who were being interviewed and the factual record that was being examined. These are features of the "environment" that run across and affect all possible future scenarios. One predetermined element that kept surfacing was, of course, technology and the impact it was having on higher education as an institution.

GBN's approach to the scenario building process did not limit the input to this planning process to participants seated around the table. Their insights were augmented by background study and research, interviews, and a special group of individuals that GBN gathered as members of their information society. GBN's network of members, to whom the problems of businesses and corporations are directed, come from a mosaic of fields, including the arts, entertainment, science, politics, and literature. The people looking at the questions and issues are not just academics, but they are all thinking and inquiring individuals. This is the real strength of the GBN.

GBN has built itself around the new information technology, and it is this technology that allows its members from around the world to examine issues and provide their unique perspectives. They are all connected to the GBN through an international computer network called the "Well." This electronic bulletin board allows the network members to react to issues raised and the scenarios being developed through various GBN projects. It helps GBN expand the source of what is known now so they are able to forge a picture of the future.

As the stories were being developed, they were shared with both the workshop participants and the network members on the Well. Revisions and adaptations were made as the stories took on greater detail. Each story was the result of an agreed upon matrix. On the vertical was the degree to which Hawaii would be inward looking or out going. The horizontal access was the strength of the economy. Based on these variables, four stories emerged that describe both pictures of the community in Hawaii and the university's role in this society. An edited version of the UHPA/GBN report on the future of higher education in Hawaii was published by NEA in the Fall 1993 issue of the journal *Thought and Action* (Ogilvy 1993).

When these scenarios were first presented to the Faculty Forum, a group of about 120 faculty from across the University of Hawaii system, the first reaction was to suggest additional scenarios. These included modifications and blending from the four stories that were developed. Again, it is noteworthy that technology played a significant role in the creation of the additional scenarios suggested. All four of the scenarios described the various degrees to which technology would impact the changing society. In some cases, technology was the "fix," while in others it was simply a recognized reality. However, all agreed that change and technology went hand in hand. The only question that remained was, "How will the changes brought on by technology manifest themselves in our universities?"

The scenarios developed with the assistance and direction of GBN have been the basis of discussions with, and presentations to, a broader segment of the community. Looking at Hawaii's future from the perspective of the role of higher education has proven to be a topic of general interest. Scenarios seem to be a comfortable way for people to plan and try to understand their future. Stories are a more natural approach for people than technical strategic planning methods, even when one is trying to understanding technology itself. It encourages broad public interest, because it is written in ways that people understand and in a form that allows them to discuss the issues. UHPA took the lead by asking these questions and then using scenario planning as a system for organizing and gathering information concerning the future.

TECHNOLOGY AND THE FUTURE

Scenario planning is not a straight line process but a cyclical activity, taking in new information and reevaluating which road is leading towards the future. It encourages its readers to fashion their own scenarios. It is as much a process of discussion and debate as it is a plan of action. In that spirit, I present an alternate scenario for American higher education that reflects the inescapable impact of technology based upon the information gathered as a part of the Hawaii higher education scenario project. One of the lessons of this project is that the future of higher education in Hawaii cannot be separated from the future of our society or the general public's views of the institutional aspects of higher education. We are all in this together.

First, let me set the technology stage with just a few points. Slowly, almost without any major notice, the impacts of computer applications have slipped into the culture and life of faculty. For over 20 years, the Internet has connected researchers and teachers in our colleges and universities. At first it was the sole realm of the military, then the scientists, but now an Internet address is just as likely to appear on the business card of a linguist. For less than $100, anyone can purchase *Windows*-based software for using the Internet, along with a phone number for setting up an account with an access provider.

The lines between communication and computer networks are converging. Telephones and facsimiles are being merged into the software of computers. You can purchase a relatively inexpensive modem-like device that converts a single telephone into a two-line speaker telephone, answering machine, and fax., eliminating the need for any separate telephone instrument.

Bell Communications Research is testing computer programs that will act as electronic receptionists and screen your calls, faxes, and E-mail, then forward calls or messages to you based on understanding your priorities, helping to flush out the junk from the information highway.

By the end of the century, the Motorola corporation plans to have completed the largest commercial application satellite project ever attempted. The project will use 66 satellites to provide direct telephone communications to anywhere in the world. One phone number is all it will take.

Dr. Dave Berque at DePaul University in Indiana is proposing a model classroom at his university to send his notes from a "blackboard" directly to the students' notebook computers. In addition, the program would annotate the margins, provide for key word searches, and integrate text and graphic examples.

There are many more examples of technological advances that provide powerful tools for teaching and research:

- Accessibility of all the public and private computer networks through the National Information Infrastructure.
- The work of the executives from 13 leading U.S. computer companies to develop new technical strategies under the 1991 Computer Systems Policy Project.
- The Hawaii Interactive Television Service that is providing distance learning opportunities and credit course work between the islands of our state, and to remote locations such as the town of Hana.
- The decreasing costs of teleconferencing equipment (less than $1000 per location) currently being used by Alexander & Baldwin, Inc., and its mainland corporate affiliates. This teleconferencing system could be used for educational purposes today without any modifications.

But technology's greatest impact may well be on our nation's 3500 colleges and universities. A subtitle to this chapter on the future of higher education could have been, "The Challenges of Technology: Do we need or want students on campuses?"

What will be taught and by whom? These are certainly not new questions, but they take on a new perspective as we face the 21st century. At the same time we consider technological advances that are changing the conditions of our higher education service, we should not ignore the attitudes of the professoriate towards their institutions and profession. The Carnegie Foundation for the Advancement of Teaching (1994) released an international survey of the attitudes and opinions of professors from 13 countries and Hong Kong. *The Academic Profession: An International Perspective* documents the low institutional loyalty on the part of individual faculty members to their institutions. Professors worldwide are saying they relate to their disciplines and fields of study, not the universities that employ them. There are closer ties to faculty members from other countries sharing in their teaching and research than to their own home institutions.

Technology offers faculty an opportunity, unlike anytime before, to be a part of a global academic community on a day-to-day basis. Faculty will now have the ability to act upon their natural independence from institutional constraints.

Reflecting on what UHPA discovered in the GBN study of higher education in Hawaii, looking at the current impact of technology's ability to offer more effective and efficient learning environments, examining the establishment of business/government/university partnerships for funding research, and understanding the ability of information technology to increase the methods for communicating, I see the potential of a future for American higher education that is quite different from the institutional organization that we have come to accept.

The following "fifth scenario" is not the necessarily the preferred future. This story is one that can be measured along the way. That is the advantage of writing scenarios. They offer us an opportunity to see where we might be headed and perhaps control those non-predetermined elements in an effort to navigate towards a more preferred port-of-call.

The Scenario: Technological Deliverance

Probably the two most significant factors that changed American higher education at the turn of the 21st century were the continued decline in the real growth of financing for public·education and the reliance upon the free market to address the educational demands of new technically sophisticated enterprises. The passage in 1996 of the amended Federal Communications Act first opened access to cable and telecommunication competition. Suddenly, cable companies could not only offer television programming, but became Internet providers. No longer were telephone companies just providing listening instruments, but out phones became computers. Since the 1930s, monopolies, large and small, had kept new and innovative companies our of these markets. Now, technology offered opportunities for businesses to have access to worldwide communication networks. One of the first new products private sector investors sought to develop was education.

The SeaHawaii Corporation was established in 1995. This for-profit endeavor sought to expand and improve upon the application of distance learning programs. One of the early failures of distance learning programs by public higher institutions was the resistance of the faculty. Although some programs were quite successful, others were just plain dull. They suffered from a lack of imagination. They were still simply television projections of the same classroom settings that had been the domain of the professoriate over the last century. They failed to utilize technology to achieve more than its broadcasting potential. SeaHawaii took a different approach.

SeaHawaii was a joint venture funded by two regional cable companies, one located in Seattle and the other in Kona, Hawaii. A partnership was formed with a consortium of faculty associations on the west coast, in Hawaii, and through the RIMPAC Organization of Faculty Unions (which included participants from former British Commonwealth states, newly independent island nations in the Pacific, Japan, Taiwan, and the Philippines).

In the past, these organizations were limited in their capacity to meet by the costs and distances involved in moving people from place to place. The introduction of fully integrated, interactive computer teleconferencing changed that equation. The organizations now had a method to communicate daily with one another, share information, and achieve consensus on how to approach specific problems, especially issues related to faculty employment between countries. One of the earliest problems discussed by the RIMPAC Organization members dealt with immigration. Universities were dependent upon an employment market that was not limited to boundaries of any one country. The expertise and knowledge of the professoriate needed to be shared. For years, research was the subject of review and dissemination through international conferences, but no one had thought of the potential of teaching being shared because of the geographical and political constraints of moving faculty from their homes to a foreign country.

The RIMPAC organization saw the possibility of bypassing institutional constraints through the development of an international "hiring hall" for faculty. These organizations recruited faculty on the basis of their expertise from around the world. These faculty were the resources that helped construct new curricular programs to be offered throughout the Pacific rim and southeast Asia. Faculty had a choice to be a part of both a national and international community of scholars and teachers. Without giving up their own institution, they became members of an outreach program free from the usual bureaucratic hassles of teaching continuing education courses for their own institutions. In fact, some faculty did choose to give up institutional affiliation for the freedom that SeaHawaii offered. It was possible for faculty to continue their research and contacts within their disciplines without relying upon specific institutional identification.

Student participants in the SeaHawaii programs were given the opportunity to complete full courses of study in their native countries. Earlier educational programs, including a medical education alternative first sponsored by the Kellogg Foundation, demonstrated that people were more likely to adapt the substance of their learning to the physical location in which they were educated. They were also predisposed to want to work outside their home country if they were educated overseas. With this information, SeaHawaii embarked on a program to identify the educational needs of specific areas and utilize technological means for access to library resources and research simulations that supported basic course presentation. This provided newly emerging nations with access to sophisticated higher education tailored to their own needs. It also ensured that, once educated, their citizens would apply their new knowledge to the people of their home country.

The success of this enterprise was based on a number of factors. The access to worldwide satellite networks through the PEACESAT and the Tonga Pacific Satellite System made it possible to receive instruction with small, relatively inexpensive receiver systems. Interactive hardware produced a "real time" experience, supplemented with easy to use computer notebooks. SeaHawaii's work with faculty organizations brought the best, brightest, and most entertaining faculty to the world. The financial incentives for the organizations and the individual faculty made this a "win-win" situation. There was no need for any administrative middleman.

At the same time on the home front, American higher education in 2005 saw a substantial reduction in baccalaureate institutions. The loss in adjusted dollars of support to state university systems, led to the closing of a number of campuses. Major state research institutions, however, continued to thrive through more aggressive research partnerships with private sector corporations. The value of basic research had resurfaced in the minds of corporate executives who realized that their business structure was not suited to that level of inquiry and that without the innovations in thinking that basic research stimulated, practical applications would soon dry up. On the other side, large universities had come to rely upon the external funding that came from applied science. A symbiotic relationship between business and education had started to flourish.

Even more than the research institutions, community colleges gained in stature and position as a result of the technological advances of the late 20th century. What had been lower skill vocational programs were transformed into high level technical education. Application specialists in the field of energy resource management, including bio-mass gasification facilities, computer simulations and artificial intelligence, language translation, broadcast technology, and aviation were all turning to the community colleges for their certification and credentials. The community college programs were moving from one-and two-year programs to three and four offerings. Higher paying jobs were the motivation, and efficient education was being offered.

Many of the community college students still desired the traditional baccalaureate degree. Partnerships were established between these community college programs and some public four-year universities. However, the community colleges were also seeking private sector educational consortia, like SeaHawaii, to provide the liberal arts component. The technological ability of these companies allowed students to take their course on the campus of the community college without the colleges having to retain a full liberal arts staff. The programs that could be offered to the students provided direct access to the best ideas, performances, and visual experiences that could be found. In many ways, student exposure to the arts and culture was broader and deeper than anything that could have been experienced 20 years earlier when there were full departments of anthropology, music, theater, or even political science. They didn't just talk about politics in political science courses. They interacted with other students from around the world.

Unfortunately, economic pressure and the changing educational needs of society had forced the closing of many of the public state four-year institutions by 2010. A strong group of small private colleges continued to provide a classical education for some students, but the four-year bachelor's degree just didn't seem like enough—or it seemed like too much. Pressure from both the community colleges and the research/graduate degree institutions made the four year state university redundant. Those that continued in academic health were either from small states, serving small population bases, or institutions that had made collaborative arrangements with community colleges on specialized degree programs, such as the aviation flight training and technology program at San Diego State. In some cases, community colleges bypassed four-year institutions and established programs directly with graduate schools. The physicians assistance program and allied health programs at the University of Michigan are good examples of this cooperative effort.

Probably the most significant factor undermining the financial stability of the four year institutions were the private sector educational corporations, made efficient through the new technologies of the communication and computer applications. In the end, changes in the nature of the curriculum and the educational needs of the population are what drove these institutions out of business.

The first decade of the 21st century also brought an increase in faculty unionism, though the nature of the contracts and representation changed. Faculty organizations were responsible for writing cross-institutional agreements. Fewer and fewer faculty were associated with one institution but rather were represented by large national and international faculty organizations. Representation had shifted from being generally collective to being based on the individual. There were still broad "industry-wide" standards and contracts, but individuals sought out faculty unions that were able to place them with institutions and private companies offering the greatest exposure for their ideas and teaching. These faculty organizations also took on a greater involvement in planning the future direction and options for higher education, because they were taking the lead in making faculty accessible to people from broad geographic locations.

Many of these organizations followed the lead of SeaHawaii and formed educational services centers. They were responding to the new K-100 life long learning society, and they actively participated in "Virtual Villages" created by a new computer age. Organizations of faculty had substituted themselves for traditional "brick and mortar" institutions. The faculty had become "the university without walls."

The roles and expectations had changed, but higher education remained as important to the societies it served as it had in preserving and discovering knowledge over the past centuries. Technology had opened the world to higher education, because there were individuals within the academy who understood the potential technology offered and chose to act upon the opportunity when it arose.

A FINAL OBSERVATION

A world where higher education is offered in a different form, or one that is more dependent upon technology, is not necessarily a less humane environment. It is not the institutions that makes higher education humane. There have been traditional universities that have given rise to environments that stifled students and cold atmospheres. Certainly, there is an aspect of higher education that has come to be the transitional social experience in America for young adults. By having the capacity to deliver higher education in a new way, will we forever give up the "freshman experience?" This question certainly deserves thought and reflection, but it applies broadly to all societal interactions that are being altered through technology. Perhaps the better question to ask is, "How can higher education continue to provide meaningful learning experiences that include human interaction and cooperative educational experiences while being presented in technologically advanced ways?"

Technology does not prevent human interaction; in fact it will offer people from geographically isolated locations an opportunity to interact with different cultures and different societies. The experiences of the Internet indicate that technology may increase the ability of some individuals to express themselves with less emotional fear. There will certainly be more opportunities for students to communicate with people whom they would never have had contact with in the absence of technology. The virtual communities of the future will not be just letters appearing on screens. They will offer sight and sound as a part of the system. There will also be individuals in the same locations sharing the same experiences, even when those experiences originate thousands of miles away. New social patterns can emerge within the context of higher education to provide the human contact that is necessary for all of us to thrive.

Technology is not an extension of the mechanistic picture of 19th century industrialization. It eliminates isolation, bringing people together into dependent interaction. It will be harder to hide the truth from individuals who have the capacity to search all over the world for explanations of current events. Technology offers the user the ability to construct a personal information network, no longer dependent upon the news gathering ability of a few agencies. The new system of learning will foster individual thought and action, although that doesn't mean eliminating different societal expectations of an individual's role. In the end, the technology itself will be value neutral.

There should be no better place to address the positive potential for technology than in the halls of the academy. Technological advancements in communications and information transmission cannot, and will not, be ignored. The higher education faculty of the world have a great opportunity in the near future to recapture their place of importance in their societies. If the sense of faculty is that they are no longer considered important to the political leaders of their nations or respected by the public for what they do, this can be addressed in the 21st century by using the new capacity of technology to reach a broader group of citizens. The professoriate have the intelligence and skill to demonstrate the constructive options that the new "Info Highway" has to offer. They can sell the cars on this road, repair them, and create the destination sites. The future is really in their hands. They can choose to utilize their intellect to fashion a new role for higher education in society.

For higher education to survive as the institution responsible for discovery and dissemination of new knowledge requires faculty to pay attention to the changes that are already upon us. How higher education is presented and offered must be seen as important as the pursuit of new disciplinary knowledge. Faculty members, not just administrators or lay trustees, must engage the community in the discussions and debates that lead to change. But there must be more than talk. We can't just be passive observers no matter how the scenarios play out. The future is not absolutely fixed (at least from this writer's philosophical perspective). We have the chance to help create and form its basic nature. We must try to understand the future before it happens.

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PART TWO

THE LAW AND UNION CONTRACTS

7

COPYRIGHT LAW AND THE INFORMATION SUPERHIGHWAY

by Kenneth D. Salomon and Michael J. Pierce

Existing copyright law was enacted long before the National Information Infrastructure was even a concept. To clarify the many legal "gray areas" found when applying that body of law to new technologies, the Administration, Congress, and federal agencies are proposing revisions to copyright law. The authors provide an introduction to copyright law and its application to digital, on-line material. Educators, they say, should be actively involved as laws are revised, seeking a balance between ownership rights and the "fair use" provisions that allow for access to and free use of copyrighted materials for education and research.

INTRODUCTION

The Information Superhighway. The Internet. The Net. The Web. The National Information Infrastructure. NII. Cyberspace. These names have come to represent what many

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believe will be the future of telecommunications in this country: A "system of high-speed telecommunications networks, databases, and advanced computer systems that will make electronic information and entertainment products more widely available and accessible to the public than ever before" (*Request for Comments on Intellectual Property Issues* 1993). One of the hoped-for results of this increased availability will be greater access to educational and social services for all members of the public. In this chapter, we will refer to this new information delivery system as the "Information Superhighway," or more formally, the "NII." We will, however, hopefully have occasion to make use of various "on-ramps," "multi-lanes," "dirt roads," and "rest areas" as we explore copyright law and its applicability to the National Information Infrastructure.

The current copyright law that is protecting the content that will flow on the Superhighway was developed long before the NII was even a concept, and technology has far outpaced that law. As a result, a number of legal gray areas emerge when these rules are applied to future and even some present applications. Policy-makers will be called upon to evaluate the continued viability of our intellectual property laws (and privacy laws) in light of the unprecedented technological advances and societal changes brought about by our arrival on the Superhighway.[1]

Why? Because we are being transformed from a society of readers, viewers, listeners, and doers into what the computer industry obliquely refers to as "end-users." Laws that were designed to protect writers, composers, sculptors, visual artists, and other authors may be obsolete in the face of a digital technology that renders meaningless the distinction between originals and copies, displays and distribution, and even authors and their audiences. Some believe that our copyright laws are in danger of becoming a quaint reminder of our less "interactive" past.

In the non-profit education sphere, institutions of higher learning see in the NII the promise of making virtually unlimited amounts of information available to scholars and students for educational and research purposes, regardless of location, time, or distance. There is a fear, however, that in the absence of clearly articulated copyright policies that encourage educational uses, the NII may not reach its full potential as a tool for scholarship and research. Much as we view the airwaves as being publicly owned, educators seem to be adopting the position that the Information Superhighway should also be recognized and treated as a national resource, access to which is essential for students and scholars.[2]

In the commercial sphere, Bell Atlantic Chairman Ray Smith has predicted that "in 10 years, Bell Atlantic will be a multimedia company in the transport, creation, and storage of information and communications. There is not going to be a 'telephone company' as we understand it." (*Washington Post* 1993, November 25). The Telecommunications Act of 1996 freed cable operators, phone companies, competitive access providers, computer companies, and even utilities to race toward the ambitious goal of becoming full service entertainment and information providers. And broadcasters, publishers, emerging programming networks, and many educators are scrambling to ensure a place for their "content" in the pipeline. Many are likely to stumble over unexpected copyright and other intellectual property obstacles.

The alliances currently being forged will seek to provide a number of information services—including television programming, telephone, PCS, computer, and hybrid services—all potentially through one wire or fiber optic cable. While the technical possibilities appear limited only by imagination and resources, the limitations imposed by copyright law will be very real. And for the new and newly-envisioned applications, the limitations have not yet even been defined.

The Clinton administration's National Information Infrastructure Task Force is taking an active role in developing the Information Superhighway, both in the technological arena and in the policy area (including protection of the rights of copyright owners). In addition, Congress, the courts, the Copyright Office, the Commerce Department's Patent and Trademark Office, the National Telecommunications and Information Administration, and the creative and user communities are all playing key roles in revising copyright law to anticipate this post-convergence world.

In this chapter, we encourage you to pull off of the Superhighway for a moment and consider the demands the NII will place on U.S. copyright law. We briefly review our current copyright laws and then summarize those areas that we believe will be subject to the closest scrutiny as the Administration, Congress, various federal agencies (including the Patent and Trademark Office and the Copyright Office), copyright owners, and users begin the process of adapting these rules laws to the future of telecommunications.

BASICS OF COPYRIGHT LAW

Copyright and Ownership Rights

The Copyright Act of 1976 ("Copyright Act" or "Act") extends copyright protection to a work at the time it is "fixed in a tangible medium." Therefore, an original work of authorship is protected from copying the moment it is written down, recorded on film, videotape or audio tape, painted on a canvas, or even entered into a computer's memory. Despite popular belief, there is no need to register a copyright with the Library of Congress in order for a work to be "copyrighted," although registration does provide certain advantages.

What Does Copyright Protect? Perhaps the most fundamental concept of copyright law is that it only protects an author's "expression," as embodied in a specific work, not the facts contained within the work and not the author's ideas. Anyone is free to copy mere facts and use another's ideas (subject to patent and trade secret laws), but *copying how a person expresses those facts or ideas* is generally prohibited. For example, anyone may make a movie about prehistoric dinosaurs coming to life in a theme park; anyone making a movie that takes too much from "Jurassic Park," however, is likely to find themselves facing an army of Hollywood lawyers.

How Long Does Copyright Protect Works? For works created by an individual, copyright lasts for the life of the author, plus 50 years. For works created by an individual acting as an employee (that is, a "work for hire"), copyright lasts for 100 years from the creation of the work or 75 years from its date of publication, whichever is earlier. Publication is an important legal concept in copyright law and occurs when a copyright owner loans, leases, sells, or gives away copies of a work. Broadcasting or otherwise transmitting a work (a television program, for example) does not constitute publication of a work, merely its "performance."[3] Performance of a work does not involve distribution of hard copies of the work.

What Are an Author's Rights? During the period of copyright protection, copyright owners have the exclusive right to:

- reproduce the work (that is, to make copies of the work).
- prepare new works based on the original (called "derivative" works).
- publish the work by distributing copies to the public by sale, rental, lease, or lending.
- publicly perform the work.
- publicly display the work.

Copyright owners may transfer these exclusive rights to others, either as individual rights, or as an entire "bundle of rights."

Copyright Registration and Notice

Registration of a work with the Copyright Office is not mandatory and may be made at any time during the term of copyright. However, there are significant advantages to early registration. First, most works must be registered before an infringement suit may be filed. Second, registration establishes a public record of a copyright, thereby discouraging others who would infringe the copyright. Third, if registration is made before or within five years of publication, it constitutes prima facie evidence of copyright validity. Finally, copyright owners may recover statutory damages (up to $20,000 per work infringed and up to $100,000 in cases of willful infringement) in lieu of actual damages, as well as attorneys' fees, if registration is made either prior to an infringement or within three months of publication.

Although copyright attaches upon creation, copyright owners should register their works and affix the appropriate notice (for example, in the form of "© 1994 Ken Salomon and Michael Pierce") to all works in order to advise the public of their copyright. While copyright notice is optional for works first published on or after March 1, 1989, it is highly recommended. Notice informs the public that the work is protected by copyright, identifies the copyright owner, and shows the year of first publication. Furthermore, the defendant in an infringement action cannot claim that he or she was an "innocent infringer" if the works bears the proper notice. (A court will usually reduce damages in cases where a defendant successfully claims innocent infringement.) Copyright owners do not need to register the work with the Copyright Office or obtain its permission prior to affixing the copyright notice.[7]

Copyright Ownership Models

Absent some other arrangement, the "author" of a work is generally its owner and is free to exploit or dispose of some or all of the exclusive rights discussed above. The Copyright Act does provide for alternative ownership arrangements, for example, between authors and those who create larger "collective" works, between joint authors, and between employers and their employees.

Collective Works. A copyrightable work may arise from the collection of other individually copyrighted works. For example, a book publisher might own the copyright in a collection of articles contributed to a themed text (such as this book), while the copyright of each article remains the property of its author(s). Unless each author expressly transfers his or her rights to the publisher, however, the publisher could only reproduce and distribute the text in its entirety.

Joint Works. The Copyright Act also recognizes that works may be owned jointly. "Joint works" are those in which two or more authors merge their contributions into a single, inseparable work. For example, the composer and lyricist of a popular song would likely be considered joint authors of the work. Each joint owner may individually exploit the work, but must "account" to his or her co-author(s) for their share of the profits earned from the work.

Works Made for Hire. The Copyright Act also recognizes that copyrightable works may be created for an employer. Works created "for hire" are those prepared by an employee within the scope of his or her employment, or that are specially ordered or commissioned as part of a limited class of works (such as "audiovisual works" like films and videocassettes), if the creator of the work signs a written agreement to that effect. Under the Copyright Act, an employer is considered the "author" of a work, and is free to exploit or dispose of the exclusive rights just as any individual author would be.

Compulsory Licenses, the Fair Use Defense, and the Non-Profit Educational Exemptions

Congress recognized through several provisions of the Copyright Act that there are circumstances under which society benefits from the use of an author's work without the author's consent (and often without compensation). As discussed below, the mechanisms that allow such non-consensual uses are not popular with copyright owners.

Compulsory Licenses. Congress has created several "compulsory licenses" under which certain users are free to exploit an author's work upon the payment of a pre-determined royalty. Typically, these payments are made to a royalty pool, which is then divided up on a regular basis among various copyright claimants. From a financial standpoint, the most important of these compulsory licenses is the cable copyright pool under which cable operators pay a semi-annual royalty for the privilege of transmitting television stations from distant locations to their cable subscribers.[5]

Other compulsory licenses cover public broadcasters, juke box owners, companies that retransmit satellite delivered television signals, and those who wish to make their own recordings of musical compositions. Not surprisingly, few copyright owners are enamored with "compulsory" licenses, believing that they would fare better in one-on-one negotiations with entities that use their copyrighted works. Also not surprisingly, various industries that utilize compulsory licenses (cable operators, for example, and the emerging direct broadcast satellite television industry) claim that they could not survive if they had to negotiate with the thousands of copyright owners whose works they exploit.

The Fair Use Defense. Unlike a negotiated or compulsory license, no compensation is paid when someone uses a copyrighted work under the "fair use" doctrine. Courts, therefore, will scrutinize a fair use defense to make sure the use truly is in the public interest.

The fair use defense to a claim of copyright infringement is generally limited to circumstances in which the unauthorized use is made for such socially beneficial purposes as teaching, scholarship, criticism, or comment. Significantly, fair use is not a bright line legal test, but it is the judicial application of four statutory criteria to specific facts of each case. These factors are:

- The purpose and character of the use (including whether it is for profit or not).
- The nature of the copyrighted work.
- The substantiality of the amount used in comparison to the total work.
- The effect of the use on the marketability of the original work.

Due to the potential ambiguities inherent in a fair use analysis, a party should consult legal counsel prior to relying on a fair use defense. The defense requires a complex legal analysis which at times can still produce contradictory answers. Judges are not restricted to analyzing the four factors outlined above, and will often look at other elements as well, such as whether the work was published or unpublished (or whether the work came from a "purloined" text). Generally, however, courts have given more leeway in the use of portions of works without permission where the work is for a nonprofit educational use. Finally, it should be remembered that fair use is a *defense* to a copyright suit, not an exception to the rights of the owner. There are costs involved in litigating a matter, even if one ultimately prevails on a statutory defense such as fair use.

Non-Profit Educational Exemption to Copyright Infringement. In drafting the Copyright Act, Congress also recognized that there are circumstances under which society as a whole benefits from the unauthorized use of copyrighted works by educational institutions. Again, because uncompensated uses are disfavored, the various educational exemptions to the Copyright Act are narrowly circumscribed. For example, one part of Section 110 of the Copyright Act permits the performance or display of a copyrighted work "in the course of face-to-face teaching activities...in a classroom or similar place devoted to instruction." (17 U.S.C.A. Section 110(1), while another part permits the performance or display electronically to distant sites under limited circumstances (17 U.S.C.A. Section 110(2)).

COPYRIGHT AND THE INFORMATION SUPERHIGHWAY

The Copyright Act, while amended in a number of ways since its passage in 1976, is still twenty-years old (and its predecessor was passed in 1909). However, while the Act may have been amended from time to time to accommodate new technologies, concepts, and judicial precedent, the *basics* of copyright law have remained fairly constant. The real issue facing telecommunications policy-makers today, therefore, is whether these basics retain their vitality in the face of the emerging NII and the power of digital technology. Does the Copyright Act, as it now stands, provide sufficient incentives and protections for authors to create works (or allow their works to be transformed into the appropriate format) for digital broadband delivery? Does the Copyright Act currently strike the right balance between commercial exploitation, fair use, and educational needs? What are the gray areas in the current law that arise when educators use telecommunications technologies to deliver instructional materials off-campus?

On September 5, 1995, the Clinton Administration's Information Infrastructure Task Force released its final report concerning intellectual property rights and the NII, entitled *Intellectual Property and the National Information Infrastructure* (the "NII Report"). The *NII Report*, prepared by the NII Working Group on Intellectual Property Rights, addresses a number of issues regarding copyright law and digital distribution of copyrighted works and proposes several changes to the Copyright Act. While it is beyond the scope of this chapter to evaluate wholesale revisions to the current law, we will note those concepts within the 1976 Copyright Act that may not ideally "mesh" with the new delivery systems and further note how the *NII Report* and the "NII Bill" introduced in Congress—the NII Copyright Protection Act of 1995, HR2441/S1284, 104th Congress, 1st Session (1995)—address these issues.

Traditional Copyright Rules in a (Non-Traditional) Digital Broadband World

As discussed above, at least from a commercial standpoint, the most important rights held by a copyright owner are the exclusive rights to reproduce, distribute, and perform a copyrighted work.[6] In terms of financial remuneration, the exclusive right to *distribute* one's work is probably the most important for writers, photographers, recording artists and other authors whose works are traditionally distributed in hard copy form to the public.[7] Specifically, the Copyright Act grants an author the right to "distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease, or lending" (17 U.S.C.A. Section 106(3)). More importantly, an author may prevent others from engaging in these activities.

Distribution. The Copyright Act does not explicitly recognize that copyrighted works may be distributed via a digital network without a physical copy ever changing hands. For example, if an Internet subscriber downloads a piece of software onto a computer hard disk without permission, it is unclear whether or not a copy has been illegally "distributed."

More importantly, it is not clear that the owner of the software could avail himself or herself to legal remedies under the Copyright Act if, in fact, the downloading was unauthorized.

The Working Group of the NII Task Force recommended and the NII Bill provided that the Copyright Act be amended to strengthen the rights of copyright owners whose materials are distributed in digital form over data lines. Specifically, the Working Group recommended that an owner's distribution right include the right to distribute a work by "transmission" (and, just as important, the right to keep others from doing so).[8] This raises, however, the issue of whether the transmission was intended as a way of distributing a "copy" of the work or merely performing or displaying the work with no intention that the recipient keep a copy for future use. For example, what is the legal effect of a piece of music being performed digitally over the NII while it is being downloaded into an end-user's computer memory?

Without going into detail, the Working Group proposed a "primary purpose or effect test" to determine if a transmission is a "distribution," or a mere performance/display of a work. As the *NII Report* asks: "If the transmitter intends both to transmit a performance, as well as to distribute a reproduction of it—or if the receiver is able to hear or see a performance of the work in the course of "receiving" a copy of it, what rights are exercised by the transmission?" (*NII Report*, 217-218). Presumably, either Congress and/or the courts will ultimately be called upon to outline the various factors that will answer this question.

Changes in copyright law affect both copyright owners and copyright users, but rarely are the benefits and burdens of change distributed evenly, and rarely do both sides react to change with equanimity. When a right, such as the distribution right, is redefined (or refined) to include an arguably new method of exploiting a work, copyright users (including educational institutions) will have to reexamine *their* contracts with authors and other copyright owners to determine if these rights have already been addressed. For example, if a university press fails to obtain the right to distribute a scholarly treatise "online," it may face a copyright infringement suit if the work then appears on its own computer server or America OnLine. Similarly, as writers, photographers, and other authors become increasingly aware of their electronic rights, they will not readily sign away their publication rights "in perpetuity, for all media now known or hereafter devised."

Publication. Recognizing the new world of digital broadband distribution, the NII Report and the NII Bill also proposed changes to the Copyright Act's definition of "publication." As discussed above, current copyright law defines publication as "the distribution of *copies or phonorecords of a work* to the public by sale or other transfer of ownership, or by rental, lease, or lending" (17 U.S.C.A. Section 101; emphasis added). Publicly performing or displaying a work is not publication under the Copyright Act. Therefore, the current definition of publication focuses almost exclusively on the exchange of *physical copies* of a work. As the law now stands, for example, distributing a digital version of a sound recording over the Internet, even with the intention that it be downloaded into an end-user's computer and retained for future use, arguably does not constitute publication of the work. In order to harmonize its recommendation that copies of a work may be distributed by transmission, the Working Group and the NII Bill advocate that the definition of "publication" be amended to incorporate publication by transmission.[10]

Publication also occurs if there is an *offer* to distribute copies or phonorecords of a work to a group of persons "for purposes of further distribution, public performance, or public display" (17 U.S.C. Section 101). For example, a motion picture is published when prints are made available to theaters under a lease arrangement. The act of showing (or, more accurately, "performing") the film, however, is not publication. Applying the analogy to the Information Superhighway, the Working Group raised the issue of whether a work offered to subscribers of an electronic bulletin board has thereby been published. Assuming that the offer is made by, or under the authority of, the copyright owner of the transmitted work, the answer would appear to be yes.

First Sale Doctrine. The NII Report also recommended a change to the "first sale" doctrine in U.S. copyright law.

Under this doctrine, the owner of a paperback book, a prerecorded videocassette, a newspaper, etc., is free to dispose of the material object as he or she wishes, including selling it, lending it, or giving it away. The Working Group recommended that this rule *not* apply to works distributed by transmission (NII Report, 1995). For example, if someone purchases a software program delivered via the Internet, that person would not be free to sell a copy of that program. One of the fundamental concepts of our copyright law—that the physical copy of a work is different from the intellectual property rights it represents—may be inapplicable in a world where original works can be effectively distributed through data line transmission with no hard copy ever changing hands. The NII Bill incorporates the Working Group's recommendation.

Therefore, although one may technically "own" a video game or multi-media title delivered on-line to his or her computer, one may soon be unable to sell, lend, or give away the product to someone else. This is similar to what happens when software is "purchased" for use on home computers. Although many people believe they own the word processing software they purchased at the local computer store, a closer look at the product packaging reveals that they are, in fact, mere licensees. Software suppliers utilize "shrink wrap" licenses to retain ownership of their products. By opening the packaging that contains the software media, consumers agree to the terms of a license under which they have no ownership rights in the work.

Is There a Lane for Fair Use on the Superhighway?

The term "Information Superhighway" may turn out to be an unfortunate misnomer for what will likely evolve into the NII. The term implies that, like drivers on the toll-free interstate highway system, NII users are free to cruise the Information Superhighway at will, stopping at whatever destination they find interesting, and helping themselves to the wares available there. Although the metaphor is appealing (particularly its emphasis on freedom, speed and fluidity), a more descriptive phrase might be the "digital turnpike." Pick your destination and pay your toll.

There will be several kinds of costs involved in accessing information on the Superhighway. On the most basic level, users will have to compensate copyright owners for the use of their copyrighted works. The fundamental premise of copyright law is that government, by granting an author a limited monopoly in his or her work, thereby establishes an incentive for the author to create that work.[11] Correspondingly, the major objective of the Working Group's recommendations appears to be one of ensuring that authors of transmitted works are able to enforce their copyrights against infringers. However, mechanisms by which compensation will flow from users to copyright owners have not been clearly identified, although publishers seem to favor some form of electronic monitoring and debiting procedures as the marketplace demands (and pirating losses) begin to justify the costs involved.

Negotiating—or "transaction"—costs are another form of "toll" that will have to be paid by users of NII-distributed copyrighted works. Notably, the Working Group dismisses the notion that transaction costs will prove a hindrance to NII access, and it simultaneously rejects the concept of "compulsory" licenses for NII-distributed works.[12] While treading lightly in this area may be appropriate now, at some point a more concrete rationale for excluding compulsory licenses in the digital arena will likely be required.

In addition to license fees and transaction costs, accessing the information superhighway will require one more form of currency: at minimum, a fairly high level of familiarity and comfort with computer protocol and procedures. These *intangible* costs of traversing the superhighway highlight what some see as a disturbing trend in America. The Working Group describes America as becoming a nation of "information haves" and "have nots" (*NII Report* 1995). Large segments of our population will have neither the skills nor the financial wherewithal to benefit from the tremendous resources the NII will likely present to the better educated and more affluent portions of our population (who also will likely be the more computer literate).

The availability of *fair use* and certain exemptions (educational uses, for example) may help mitigate the first two kinds of "costs" discussed above. Under these precepts, certain uses of NII-distributed works would neither require the payment of license fees nor impose the burden of negotiating for use of the works. For example, if the Copyright Act's Section 110(2) exemption for certain "closed circuit" transmissions were expanded to include non-classroom sites, educators would not be faced with the costs of clearing rights for NII distribution (and the potential license fees associated with distributing materials to non-classroom sites).[15]

Such accommodations for educational uses are not without precedent. For example, when the Copyright Act of 1976 became law, Congressional committees with copyright oversight helped private sector owners and users develop certain "guidelines" to define the scope of fair use for the copying of text and the use of music for classroom purposes. In 1981, guidelines covering the off-air taping of copyrighted works for educational uses were implemented. These understandings between educators and copyright owners have served as "safe harbor" standards for fair use and have, to some degree, reduced uncertainty and transaction costs for educators. However, neither the legislative policy of the Copyright Act nor the fair use guidelines contemplated the deployment of the NII or the dramatic changes in the delivery of educational services, including delivery to homes and work sites.

While the Working Group has not yet taken any position on the role or application of fair use in the digital broadband context, it seems receptive to a regime that maintains the current opportunity for researchers, students, and others to "browse" through digitally distributed copyrighted works (*NII Report* 1995, 144). Their position seems to be that information, simply because of its availability via a digital broadband network rather than in a traditional library, arguably should not be subject to greater restrictions than it currently is.

To begin to address these issues, the Working Group has convened the Conference on Fair Use (CONFU). The conference includes representatives of libraries, education, publishers, and other copyright owners whose rights may be affected by amendments to the Copyright Act. CONFU is an effort to facilitate the development of an agreement between authors and users on the scope of fair use on the NII. CONFU has divided into committees that are attempting to draft a series of digital fair use guidelines, including ones for distance learning, electronic multimedia, and libraries. If succcessful, these will provide educational safe harbors like the earlier agreements.

In addition to providing for appropriate uses by nonprofit educational institutions, fair use is also designed to insulate those engaged in criticism, comment, and news reporting. At this point in time, however, the Working Group has not suggested any changes to the fair use laws as they relate to *non-educational* users. Instead, the Working Group may be inclined to rely on the courts to reconcile journalistic fair use, for example, with the tantalizing availability of information on the NII.

Educating Ourselves Beyond the "Superhighway"

Today, many people view the Information Superhighway as little more than a vague and overly-hyped concept in search of a marketplace structure (and probably large corporate investment). No one has put forth a realistic timetable for deployment of the Superhighway or even described the intended results in more than the vaguest terms. However, take away the hyperbole and one is still left with the wondrous notion that anyone may soon be able to access a substantial portion of the world's accumulated knowledge and artistry.

While the horizon of this new landscape may still be hazy and the road to getting there scarcely clearer, there is one undertaking recommended by the NII Working Group that may lift some of the fog in this area. The Working Group recommended, and the NII Bill adopted, a provision requiring that efforts be made to ensure effective public education about intellectual property rights. As the *NII Report* states: "There is a general lack of awareness by the public about intellectual property rights in their own works, as well as in the works of others" (117).

Presumably, a greater awareness of intellectual property rights could lead to a nation in which citizens feel that they have a real stake in the development of the NII. To date, the discussions seem to have largely been dominated by those with either a clear commercial interest in the Superhighway or whose institutional missions might be compromised if commercial interests predominate. If, in fact, the Information Superhighway is to be this country's next great public resource, it will be important for all citizens to be aware of its potential.

CONCLUSION

This country's copyright tradition of empowering authors is not likely to be challenged by the long-awaited arrival of the Information Superhighway. The premise that authors will create if they are compensated for creating appears unshakable, and changes that strengthen the rights of authors in the face of new technology would seem, ultimately, to be for the good of all. Changes to ensure that non-profit and educational institutions can continue to use copyrighted works for educational and research purposes would also seem to be for the good. The trick, therefore, will be to only make those changes that accomplish both of these goals. For that to happen—for the right balance to be struck—educators (and distance educators in particular) must be actively involved in the process.

NOTES

1 For example, distance learning, the process of providing classroom instruction to students at home, in the workplace, or at other off-site locations, including classrooms, libraries, and learning centers, will take on a whole new dimension when combined with digital, broadband delivery. It is currently not clear, however, that the Copyright Act will permit the distribution of some types of educational materials in a distance learning context beyond the traditional classroom. Full utilization of the NII in this area will likely require amendments to the Copyright Act, as discussed more fully below.

2 See, for example, *The National Public Telecommuni-*

cations Infrastructure Act of 1994, S.2155, 103d Cong., 2d Sess. (1994). This legislation would have created free public rights-of-way on the NII for educational uses, among others. This bill proved to be the genesis for the universal service provision of the landmark Telecommunications Act of 1996, which guarantees affordable rates to advanced telecommunications services, such as the Internet, for schools, libraries, and health care providers.

3 To perform a copyrighted work publicly is to transmit or otherwise communicate a performance (i) at a place that is open to the public or (ii) by means of a device or process by which members of the public receive the performance, whether simultaneously or not. Plays, songs, readings from books, choreographic works, and motion pictures are examples of works that may be performed publicly.

4 In order to register a work, copyright owners must complete an application form, pay a filing fee (currently $20.00), and deposit copies of their works with the Copyright Office.

5 Generally, television stations that are more than thirty-five miles from a cable system and that do not place a strong broadcast signal over the cable system are considered "distant" to the cable system. Because television stations generally do not receive payments from advertisers for viewers not located in their immediate transmitting area, the compulsory license attempts to replicate the payment that a cable operator would make to a distant television station as a result of free-market negotiations.

6 One other important right held by a copyright owner is the right to produce "derivative" works based on an original work. (For example, the owner of a play owns the exclusive right to produce a motion picture based on the play.) Concerns have been raised, however, about the ability of universities and libraries, for example, to create "digitized" versions of works in their archives for access via the NII. Presumably, unless the law is changed, creating a digitized version of a pre-existing work could violate an author's exclusive right either to reproduce the work or

create a derivative work.

7 In contrast, the owner of a television program or theatrical motion picture would likely believe that the right to publicly "perform" a work is the most valuable.

8 To "transmit" a performance or display of a work is to "communicate it by any device or process whereby images or sounds are received beyond the place from which they are sent." 17 U.S.C.A. Section 101.

9 Federal district courts have initial jurisdiction over copyright cases. Because judicial decisions only serve as precedent (i.e., their rulings must be followed by lower courts) in specific geographic areas, there initially may be regional standards for differentiating between a transmission that is either a "distribution" or a "performance/display." Given the national (and, ultimately, international) breadth of the Superhighway, however, harmonizing these potential disparities will take on some urgency.

10 The Working Group would define publication to include the distribution of copies or phonorecords of a work to the public by sale or other transfer of ownership, by rental, lease, lending, *or by transmission (NII Report,* Appendix 1, 2)

11 Article I, Section 8, Clause 8 of the U.S. Constitution states: "The Congress shall have the Power...To promote the Progress of Science and the useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."

12 "[T]ransaction costs—and the attendant savings from compulsory licensing—can be minimized in a digital environment." "The marketplace should be allowed to develop whatever legal licensing systems may be appropriate for the NII." (*NII Report* 1995, 52-53).

13 Section 110(2) exempts the performance or display of a work over a closed-circuit telecommunications system if made for purposes of instruction conducted on a systematic basis and primarily for reception "in classrooms or similar places normally devoted to instruction." It is unclear whether this closed-circuit, location-specific, exemption would apply to delivery of instructional materials to, for

example, the work place or even the home (perhaps via Internet or cable television delivery). Educators would likely argue that, rather than focusing on the geographic destination of distance learning transmissions, Section 110(2) should focus on factors such as the purpose of the transmission and the subject matter and content of the transmission. Arguably, as long as the primary purpose is education and there is a group of course-enrolled students who receive the NII transmission, the exemption should apply.

8

NEW FRONTIERS IN COPYRIGHT LAW

By Linda K. Enghagen, J.D.,

Copyright issues are increasingly important for university faculty members, says the author. Limited budgets for institutions and the shift to an information-based economy have increased the salience of questions about both ownership and use of copyrighted material. After outlining the copyright law, the "teacher exception" and "fair use" provisions, she discusses the "uncharted territory" of video and broadcast materials. The most prudent course—be informed before using materials and insist on specific agreements about ownership before developing products.

INTRODUCTION

University faculty members encounter intellectual property issues in a myriad of contexts. Some are traditional issues such as the "fair use" questions concerning course anthologies resolved in the *Kinko's* decision. Others expand into new frontiers. Distance education, live broadcasts, and videotapes, for example, create new questions of copyright ownership. Distance education also establishes a record of the conduct of a course. Copyright infringement in that case can be more easily documented by the copyright owner.

The upheaval in the U.S. economy during the past several years left many institutions in weakened if not poor financial condition. Revenues generated by commercially viable creations and inventions provide possible avenues for recouping some of those losses. In fact, to the extent the economy increasingly relies on information as a saleable commodity, universities are poised to play a greater role than ever before. These trends accentuate the importance of copyright questions in academe.

COPYRIGHT LAW

General Rules

Copyright law governs the ownership and use of copyrighted material. To provide the owner with an incentive for undertaking the risks inherent in creative activity, the owner is granted a limited monopoly in his or her creations. Typically, the creator is the owner of the copyright unless the work was created by an employee in the course of his or her duties, or the work was created pursuant to a "work for hire" agreement. In the case of an employee, the owner is the employer. In the case of a work for hire agreement, the contracting party becomes the owner.

Copyright owners possess five exclusive rights in the copyrighted work.

1. The right to reproduce the copyrighted work.
2. The right to prepare derivative works based on the copyrighted work.
3. The right to publish the work by distributing copies to the public by sale, rental, lease, or lending.
4. The right to publicly perform the work.
5. The right to publicly display the work.

Teacher Exception

Courts and commentators have long acknowledged the "teacher exception." Essentially, this exception permits teachers to retain the copyright to their lectures and other work products even though the products were created as part of their job responsibilities. In one of the only court decisions to look at this question, a California Court of Appeals (*Williams v Weisser*) concluded that because a professor never assigned his copyright in his lectures to the university, he owned them.

Williams was decided in 1969 under the then applicable Copyright Act of 1909. Since that time, Congress revised the law under the Copyright Act of 1976 which, among other things, redefined what falls under the "work for-hire" category. Some commentators argue that the new characterization of work for hire abolished the "teacher exception," but that claim is based on their *interpretation* of the new language. The Copyright Act of 1976 does not *explicitly* eliminate this rule. Other commentators argue that the Copyright Act of 1976 does nothing of the kind. But no post-Copyright Act of 1976 cases have resolved the argument. Unless and until a court overrules *Williams*, it is fair to continue to conclude that absent an agreement to the contrary, professors own the copyright to work created as part of their job responsibilities.

Fair Use Defense

The fair use defense is an exception to general copyright law, allowing users of copyrighted material to deflect liability when accused of copyright infringement (unauthorized use). The fair use defense is found in Section 107 of the Copyright Act of 1976.

The fair use of copyrighted work, including use by reproduction in copies or phonorecords or other specified means, for criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research is not an infringement of copyright. Factors considered in determining whether the use made of a work in any particular case is a fair use include:

1. the purpose and character of the use, including whether the use is commercial or for nonprofit educational purposes.
2. the nature of the copyrighted work.
3. the amount and substantiality of the portion used in relation to the copyrighted work as a whole.
4. the effect of the use upon the potential market for or value of the copyrighted work.

In evaluating a case under the fair use provisions, court decision are made after weighing and balancing the use in question on these four factors. The Kinko's course packet case is a recent fair use case.

The Kinko's Case

In March of 1991, the United States District Court for the Southern District of New York ruled against Kinko's in a well publicized course anthologies case. A number of publishing companies sued Kinko's for copyright infringement. The suit claimed that Kinko's sold university course packets that included copies of articles and excerpts from books without obtaining permission or paying royalties. Kinko's claimed it was in no different position than a professor who makes copies for classroom use and was thereby protected by the fair use defense. The court disagreed.

While the court took 20 pages to render its decision, it found the heart of the matter to rest in the for profit, commercial nature of Kinko's business. The fair use defense was never intended to protect commercial activity, even when the organization engaging in the commercial activity is a not-for-profit educational organization. Commercial activity is presumptively "unfair" under the fair use defense. Consequently, Kinko's profit generating course packets were found to violate the fair use defense and constituted illegal copyright infringement.

The Distance Education Environment

The application of copyright law to the distance education environment is a relatively new application of an old doctrine. In the typical case, a faculty member owns his or her prepared notes and other course materials. But in the absence of a specific agreement, ownership of live broadcasts and videotaped courses is less clear. On the one hand, if the one word course is broadcast or taped as part of the faculty member's regular duties, the university may claim ownership as the employer. On the other hand, as the owner of the underlying notes and materials, the faculty member may claim ownership on the basis that the broadcast or videotape is a derivative work. There are a few cases in similar contexts that support faculty ownership rights. The court found these later products to be derivative works: an instructional videocassette based on a book, a televised speech given from a manuscript, a computer program based on a manual describing a method of trading commodities, and a modified version of copyrighted architectural plans. Clearly, the most prudent course for everyone to take is to agree *in advance* on ownership interest in the products created.

Since the holder of the copyright is entitled to control whether and how a product is used, ownership of distance learning material also becomes important in determining how often and where those materials are used. It's not difficult to imagine that some institutions will be tempted to use one professor taping a course to cover multiple sections of students. English 101 can be taped once and shown to many sections. How often can this be done? How often do taped courses need to be updated to be current? Who evaluates the students' work? Who is available to students? How does this factor into a faculty member's work load and compensation? Is this an appropriate substitute when a faculty member is on a sabbatical? Can the institution retain and continue to use a taped course after a professor has retired or resigned to take a position elsewhere? A prior agreement can provide the answers to these questions. Otherwise, they will be answered largely by a court decision on who owns the copyright to the tapes and broadcasts. The owner controls the use of the work.

Fair Use: Broadcast Programs and Videos

A related issue, the application of the fair use defense to broadcast and videotaped programming, is not completely settled. Some guidance can be found in *The 1981 Guidelines for Off-Air Recording of Broadcast Programming for Nonprofit Educational Purposes*. Essentially, these guidelines allow off-air recording for nonprofit educational use but place significant restrictions on this practice. Unlike the guidelines for photocopying, these guidelines are not widely known. The entire text is included here.

GUIDELINES FOR OFF-AIR RECORDING OF BROADCAST PROGRAMMING FOR EDUCATIONAL PURPOSES

1. The guidelines were developed to apply only to off-air recording by non-profit educational institutions.
2. A broadcast program may be recorded off-air simultaneously with broadcast transmission (including simultaneous cable transmission) and retained by a non-profit educational institution for a period not to exceed the first forty-five (45) consecutive calendar days after date of recording. Upon conclusion of such retention period, all off-air recordings must be erased or destroyed immediately. "Broadcast programs" are television programs transmitted by television stations for reception by the general public without charge.
3. Off-air recordings may be used once by individual teachers in the course of relevant teaching activities, and repeated once only when instructional reinforcement is necessary, in classrooms and similar places devoted to instruction within a single building, cluster, or campus, as well as in the homes of students receiving formalized home instruction, during the first ten (10) consecutive school days in the forty-five (45) day calendar day retention period. "School days" are school session days—not counting weekends, holidays, vacations, examination periods, or other scheduled interruptions—within the forty-five (45) calendar day retention period.
4. Off-air recordings may be made only at the request of, and used by, individual teachers, and may be regularly recorded

in anticipation of requests. No broadcast program may be recorded off-air more than once at the request of the same teacher, regardless of the number of times the program may be broadcast.

5. A limited number of copies may be reproduced from each off-air recording to meet the legitimate needs of teachers under these guidelines. Each such additional copy shall be subject to all provisions governing the original recording.
6. After the first ten (10) consecutive school days, off-air recording may be used up to the end of the forty-five (45) calendar day retention period only for teacher evaluation purposes, i.e., to determine whether or not to include the broadcast program in the teaching curriculum, and may not be used in the recording institution for student exhibition or any other non-evaluative purpose without authorization.
7. Off-air recordings need not be used in their entirety, but the recorded programs may not be altered from their original content. Off-air recordings may not be physically or electronically combined or merged to constitute teaching anthologies or compilations.
8. All copies of off-air recordings must include the copyright notice on the broadcast program as recorded.
9. Educational institutions are expected to establish appropriate control procedures to maintain the integrity of these guidelines.

This area of fair use is less settled than fair use of print material, in part because these guidelines were not incorporated into fair use *law* enacted by Congress. The guidelines, along with others covering photocopying and the use of music were incorporated only into legislative committee reports as the statutes were drafted and debated.

As video and broadcast technology becomes more readily available, the opportunity and temptation to infringe another's ownership rights will increase. Something as seemingly simple and harmless as a home VCR has dramatically increased the opportunity for unlawful infringements. For example, using a home VCR to copy a program from television for later use in a classroom often violates the guidelines outlined above.

CONCLUSION

Faculty members will continue to encounter intellectual property issues in the course of their duties. While the legal issues are settled for many of the traditional facets of classroom instruction and research, new frontiers have arrived in the areas of distance education and the impact of developing technologies. For all concerned, the most prudent course is to be informed of all of the laws and regulations that might apply, and when venturing into uncharted territory to enter into specific agreements in advance regarding ownership rights in the products that result from such labors.

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9

INTELLECTUAL PROPERTY AND FACULTY COLLECTIVE BARGAINING: THE CANADIAN EXPERIENCE

By Donald C. Savage and Patricia A. Finn

The Canadian Association of University Teachers (CAUT), the national collective bargaining agent representing higher education employees across Canada, moved in the 1970s to develop model clauses for collective bargaining agreements, providing protections for faculty rights in copyrights, patents, and technology transfer. These model clauses became part of many local college and university contracts. While U.S. and Canadian copyright and patent law, as well as collective bargaining processes, differ, CAUT's strategies and the model provisions themselves can be models for U.S. faculty unions.

The Canadian Association of University Teachers (CAUT), formed in 1951, is the sole national organization of university academic staff across Canada. CAUT's 28,000 members also include community college teachers in British Columbia. About half the membership is covered by collective agreements negotiated under Canadian labour law, including virtually all the community college teachers in British Columbia.

CAUT first became involved in collective bargaining in the late 1960s (Savage 1994). As collective bargaining spread among CAUT local associations in the 1970s, CAUT created model clauses in many possible areas of collective bargaining, seeking to include them in all negotiated agreements. The employers did not follow suit. Faculty association bargaining agents, as a consequence, had a distinct advantage for more than a decade (Cameron 1991).

The association urged bargaining agents to negotiate *all* terms and conditions of employment of the local members. CAUT's development of model clauses on issues of importance to its members had two goals: (1) to facilitate bargaining by member associations and unions, and (2) to ensure that poor bargaining at one institution did not negatively affect staff at other universities,. The model clauses were debated, refined, and officially adopted by the CAUT Council, comprised of representatives from all university associations/ unions in Canada.

The strategy was quite successful: Most Canadian contracts cover a wide range of areas including appointments, probation, tenure, promotion, sabbaticals, dismissal, rights and responsibilities, academic freedom, freedom from discrimination, salaries and benefits, rights of the bargaining agent, and grievance and arbitration procedures. Canadian labor law, unlike that governing negotiations at many U.S. colleges and universities, does not limit the areas over which the parties bargain. In fact, CAUT's member associations have negotiated such things as the creation of faculty councils and senates—topics that may be non-mandatory or even prohibited subjects for U.S. public college and university negotiations. In Canada, the only prohibition is the violation of other laws. If, for example, an academic senate is created by statute, then it cannot be abolished through collective bargaining.

As part of its overall strategy, CAUT urged that university copyright and patent policies affecting academic staff be negotiated as part of collective agreements and drafted model articles on patents and copyrights. The great majority of Canadian collective agreements contain such clauses as a result of this effort.

Both copyrights and patents should belong to the creator, argued the faculty associations and unions, although certain circumstances might modify this principle. Why? To encourage creativity and entrepreneurship and to allow faculty to augment low salaries through patent and copyright income, helping to retain creative people in areas of high demand.

In the area of copyright, Canadian law holds that the employer owns the copyrights of its employees unless there is a contract to the contrary. Articles written by newspaper reporters, material generated for private corporations, and the like would all normally belong to the employer. But traditionally in Canada, it was understood that the copyrights in books and articles written by university faculty would belong to the creator. So too would the lecture notes created by professors for their courses.[1] Copyright ownership for computer programs, films and videos was much less clear. With the advent of collective bargaining, it seemed better to be safe than sorry, explicitly incorporating the principle of ownership by the creator within collective agreements. Otherwise it might later be considered a management right.

The faculty ownership principle is enshrined in a simple clause: "Except as herein specified, the employer transfers to the author(s) the copyright(s) in any intellectual property produced or created by the member."[2]

Exceptions ensure that academic staff cannot claim copyrights in any assessment, grading, report, or correspondence that is part of their normal administrative duties within the university. The provisions also give the employer a nonexclusive, royalty-free, indivisible, and nontransferable right to the use of any computer program developed in the course of the normal administrative duties of the member or any program developed for the retention of university data and records.

Video and film ownership issues are more complicated than those for print materials. When the university broadcasts lectures, CAUT recommends that the copyright remain with the lecturer. The video cannot replace the lecturer unless that person agrees. If the university has professional film and video studios and produces works for sale or for use by others outside the university, a license must be developed for use and resale. That license provides for sharing of economic benefits, if any, by the creators and the university.

CAUT also strongly recommends that the license contain agreements about the storage, editing, subsequent use, and withdrawal of outdated material. Staff members have sometimes discovered—to their great intellectual embarrassment—that their videotaped lecture was sold and broadcast years later when events and circumstances had clearly changed. CAUT recommends that the license be a protocol attached to the collective agreement.

The copyright provisions recommended by CAUT also ensure that the collective agreement applies to works of art and music, particularly important where the university has a fine arts or music faculty. There have been some nasty disagreements in Canadian universities about who owns the paintings on the wall. This provision ensures that the creator does.

Computer programs in Canadian law normally fall under the copyright rather than the patent act. Canadian university collective agreements made this clear when the legal situation in Canada was still uncertain. This protection is particularly important for engineering and science faculties.[5]

The same principle of ownership by the creator should apply to patents, according to CAUT's standards. In Canada, patents belong to the employer if the property developed is directly related to the creator's employment.

Faculty members are not usually required as a condition of employment to develop patentable property. So the faculty member normally owns the property unless there is a contract to the contrary. CAUT's position has been that patents should belong to the creator. Starting from that position, the question then becomes one of whether the employer university is entitled to share in revenue generated by a patent. With the exception of the University of Ottawa, all Canadian agreements state that the university is not automatically entitled to a share. Agreements do recognize a need to allocate shares in the profits when the university makes special contributions to the development of the patent. And special contributions, CAUT has argued, should mean just that—not simply the payment of salary or the normal use of a laboratory.

If the university has provided funds, personnel, or facilities beyond those normally provided to faculty members to carry out their jobs, the university is seen as an investor in the intellectual property and entitled to a share. If the university's agency is used to patent an invention, then the university also becomes entitled to a share.

Generally, the sharing is 50/50 between the inventor and the university. Sometimes the parties negotiate and conclude a contract on the shares. In four cases, collective bargaining agreements provide for an unequal split, with one university having a 75% faculty/25% university split. In another four instances, the university, must allocate all or part of its share of the profits to the originator's department or to support research/scholarly activity.[4]

CAUT's standards do provide for some employer rights. The employer should have a nontransferable, nonexclusive and royalty-free right to use patents developed at the university with the use of the employer's funds, support, or technical personnel. Conversely, however, the faculty member should have the right to publish and should not be required to patent any discovery.

A complicating factor emerges with research contracts between the faculty member and the private sector. Canadian firms, like many U.S. firms, require those who contract with them to assign them ownership. It would be nice to resist this, but in practice it is impossible. To provide for employee rights in this situation, CAUT has recommended that such contracts provide for a review by a parity committee of the employer and the union. Through this review, union representatives can try to ensure that the contracts are reasonably fair to the researchers and to any graduate students involved. Such committees exist in many Canadian universities, frequently mandated by the collective agreement, though there has been no analysis of their effectiveness.

Given that faculty for the most part own their intellectual property, it follows that they may patent their inventions themselves. The cost of patenting an invention runs at about $20,000, and the process is lengthy and time-consuming, rarely taking less than three years to complete. The technical feasibility of the invention must be tested through a prototype. Experts in the field may be needed to provide an assessment or the services of the Canadian Industrial Innovation Centre in Waterloo may be utilized to carry out their Critical Factor Analysis. Patent searches must be undertaken in the Canadian Patent Office[5] and, if warranted, in the U.S. Patent Office. Market surveys may be necessary. If all the initial steps are positive, a patent agent is necessary to file a patent application. A year may elapse before the patent office takes its first action. All the possible vehicles of technology transfer must be assessed by the inventor, followed by marketing and signing an agreement.

It is little wonder that few faculty are in a position to patent their inventions without assistance. This assistance is often provided by the university, and at that point potential revenues are normally allocated between the inventor and the university.[6] In order to provide a stable set of rules, universities developed policies which, with the advent of collective bargaining, were refined and codified. The basic principle, found in all but one collective agreement remains that faculty own their inventions.

Technology transfer can be achieved without patent protection in a variety of ways, such as licensing. The most common means of technology transfer in universities is that of faculty publishing their results. Another, licensing, is a speedier process than patenting and can help get an invention into the market before the competition. While publication does not necessarily result in revenue for either the faculty member or the university, licensing can provide revenue.

Review of the Canadian higher education collective agreements and policies show that the standards adopted by CAUT in the 1970s have ensured that patents and copyrights at universities in Canada are regulated in much the same manner. The regulations, by and large, conform to CAUT policy statements. One faculty association constitution even contains a bylaw requiring that the collective agreement brought to the membership for ratification be consistent with CAUT guidelines.[7]

Many more Canadian faculty own copyrights than patents. Thus the development of the copyright articles of collective agreements has had a much greater impact than those on patents. More recently, the revision of contractual language for collective agreements on technology transfer has occupied negotiators during collective bargaining.[8]

One example of the importance of these articles in Canadian collective agreements could be seen in the panic generated by the need to create policies on fraud and misconduct in research. Concordia University in Montreal set up a committee to draft policy in the area. The policy initially included a recommendation that the university should seize and own all the patents of faculty. When it was pointed out to the committee that there already was a provision in the collective agreement recently ratified by the board of governors which took the contrary view, the committee retired from the battlefield. One can imagine the result if there had not been a collective agreement with clear provisions on copyrights and patents.

In addition to regulation through collective agreements, many faculty associations and universities without formal collective bargaining (non-certified) have policies regulating patents and copyrights. These policies closely mirror those found in the bargaining (certified) settings. This similarity developed through the interaction of both certified and non-certified associations in developing CAUT guidelines and through the "knock-on" effect of collective bargaining.

NOTES

1 Smith and Sternberg (1994) in an opinion on the legal situation in the United Kingdom on lecture note: "The first misconception concerns the ownership of copyright in an academic environment. Many universities assume that they own the output of their staff, either because this is specified in employment contracts, or because of the rights of an employer under the general law. This must be balanced, however, against the firmly entrenched custom and practice of British universities, which has traditionally treated a lecturer's notes as his or her own and has permitted them to be

taken from institution to institution with the lecturer. Even a relatively tightly drawn employment contract would not necessarily override this...unless this (material) has been specially commissioned." The authors are writing about the copyright side of creating multimedia packages.

2 Contrast this with DeLoughry (1994) who reported the following comments: "Others at the meeting said that colleges should retain the rights to texts and images created by professors and should use those materials in multimedia programs. 'There is nothing illegal about it and there is nothing unethical about it,'' said Chuck Schneebeck, director of academic computing services at the California State University at Long Beach. "I think it's a right that we have."

3 See the collective agreement, October 9, 1981, Technical University of Nova Scotia, a university with an exclusively engineering and architectural curriculum. This agreement also covered such matters as architecture drawings and engineering plans.

4 **Acadia University**: "Any revenue which the Employer may receive from inventions shall be used for University research with 50 percent of such income designated for research in the Department or School with which the inventor(s) is (are) affiliated. These funds shall be maintained in a special account which shall be open for inspection to the President of the Faculty Association or his/her delegate."

Lakehead University: "Any revenue that the Board may receive...shall be dedicated to research and dispersed at the Board's discretion except that in each case 25 percent of such income shall be assigned by the Department in Arts and Science or the School in Professional Studies with which the member concerned is affiliated. The Board's auditors shall certify in writing annually to the Association that these funds have been expended in accordance with this Article."

Laurentian University: "Any revenue which the Employer may receive from inventions shall be dedicated to academic development and research with at least fifty (50) percent of such income designated for academic development and research in the Faculty/Library with which the inventor is affiliated. These funds shall be maintained in a special account which shall be open to the inspection of the President of the Faculty Association or the President of the Faculty Association's designate."

Memorial University: "The University's share of royalties shall be used to support research and scholarly activity."

5 Only 0.3 percent of world patents are Canadian

6 In the case of the University of Alberta, which is not certified under labor law, faculty have a choice of retaining ownership of their patentable intellectual property or assigning it to the university for development, which explains why the University of Alberta holds 105 patents while its 27 spin-off companies hold 160 (figures from the *Edmonton Journal*, June 5, 1994). Although the university holds the patent, revenues are shared with the creator.

7 *Carleton University Academic Staff Association By-Law 3: CAUT Guidelines:* "Any collective agreement proposed by the Association shall be generally consistent with the guidelines published from time to time by the Canadian Association of University Teachers (CAUT)."

8 **Carleton University**

14.2 **Technology Transfer**

(a) Technology transfer represents the movements of concepts, processes and products generated and developed at Carleton University to external communities including industry, government and society at large. This transfer of technology is undertaken in a variety of ways including, but not limited to, publication of research results and concepts, consulting arrangements, conduct of seminars and conferences and various types of research arrangements.

(b) The parties recognize that Carleton University supports technology transfer in all its dimensions and the commercialization of the concepts, processes and products emerging from the research at the University.

(c) Assistance for technology transfer and commercialization is available through the Graduate Studies and

Research Office of Carleton University and through Carleton University Development Corporation.

(d) Assistance for inventions may take a variety of forms such as the following: technical evaluation, market evaluation, prototype development, industrial contacts and leads, business planning, new product planning, market research, financial planning, licensing arrangements, and protection of intellectual property.

(e) **Ownership**

Where there has been use of the employer's funds, facilities and/or support or technical personnel the employee and the employer shall reach a mutually agreeable arrangement respecting ownership which shall be reduced to writing.

(f) **Exploitation**

(i) Exploitation of intellectual property through technology transfer may be undertaken by the originator singly or in combination with another party.

(ii) The parties exploiting the property shall reach a mutually agreeable arrangement including ownership and revenue sharing which shall be reduced to writing.

(iii) In the event that the employee reaches an agreement to use the offices of the University or the Carleton University Development Corporation, disputes shall be handled in accordance with Article 14.5. Individuals using the offices of external agencies should include a dispute resolution mechanism in their written agreements.

(g) Article 14.2 shall not apply to any technology resulting from work financed by a grant or contract where the granting or contracting body, as a condition of the grant or contract, requires that any technology rights be assigned to it.

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PART THREE

TECHNOPHOBIA POINT AND COUNTERPOINT

10

TECHNOPHOBIA

by Carol Baroudi and John Levine

Technophobia—the undue fear of and contempt for technology—is common even among highly educated people, say the authors. What makes a technology intimidating? It isn't familiar, people can't see how it will be useful to them, and they don't feel in control of it. Using computers as an example, the authors explain how and why the technophobics can come to accept and even embrace technologies they once feared.

"Technophobia," as yet, remains undefined in our dictionaries. However, we can take a cue from "xenophobe" which the *American Heritage College Dictionary* defines as "a person *unduly* fearful or contemptuous of that which is foreign." So if we talk about technophobia as *undue* fear and contempt of technology, and specifically of computers, we have a starting point.

It's the "undue" part I want to address first. For the most part, I think we're all too accepting and welcoming of technology into our lives. Or maybe we've given up and think it's inevitable. I know I'm disturbed that when I call the phone company to report a problem I talk to a computer. Worse than that, when the repair is done the computer calls me back. If we think that this isn't erosion and that we won't pay for it dearly, I think we're deluding ourselves.

But there is technology on which I am highly dependent. I drive a car, use the phone, use an ATM at the bank, and use a computer to write. And I think most of us fall into this category. So the issue of technophobia arises when someone could benefit from using a technology, particularly from using a computer, but her own fear or contempt prevents her from doing so. Fear and contempt are not really two different things. If you scratch the surface of contempt, you'll find it's rooted in fear.

My experience says that women have this fear, or admit that we have this fear, to a greater extent than men. Women are generally more scared of computers—not scared in the sense that the computer will do us some harm (maybe we should be afraid of that) but scared that we are going to break something or that we are going to do something wrong and everything will explode. This fear, by the way, is still common even among very educated, very bright people—graduate students at such places as MIT—who aren't in a computer-related field or who don't rely on computers for their research.

WHAT MAKES A TECHNOLOGY INTIMIDATING?

Why is it that many people fear computers, while in our society almost nobody fears automobiles, even though automobiles are just as difficult to use and, unlike computers, can kill you if you use them incorrectly? There appears to be three criteria which a technology must satisfy for people to accept it: familiarity, usefulness, and control.

Familiarity

The first and most important criterion is that a technology be familiar. Our homes and offices are filled with familiar technology: automobiles, television sets, central heating, microwave ovens, photocopiers, VCRs. As we approach the end of the twentieth century, the list is endless. Much of this technology was unknown when our parents or grandparents were young, but children now take it for granted. The story about a family where a small child is the only one who can operate the VCR has become a cliché. A generation that has grown up with a technology no longer gives it a second thought.

Usefulness

The second essential criterion is that a technology be useful. Every familiar technology was new once, and something must have propelled it into people's lives. That something is usefulness. VCRs, an exotic novelty in 1970, became utterly commonplace once people realized that with a VCR they could see movies without being constrained by a theater's schedule or by having to leave home and arrange for child care. Automobiles became ubiquitous once people understood that they offered transportation with a speed, flexibility, and privacy that horses and railroads could not match. In each case, the usefulness of a technology has to be simple and direct in order to be appreciated. Computers have long suffered from what one might call a "diffuse utility." There are many areas where they can be useful, rather than a single direct area where their advantage is directly overwhelming. Computers achieved acceptance in the office in the 1970s and 1980s because each of a small set of so-called "killer applications" offered a clear advantage: word processors for document preparation, databases for filing, and particularly spreadsheets for budgeting and analysis. Each of these was useful enough that users would buy a computer to run a single program, treating is as a useful single-purpose appliance rather than as the general purpose device that it is. But the utility of a single purpose appliance is far easier to appreciate.

Control

The final critical criterion is that the user must feel in control of technology. When a driver gets behind the wheel of an automobile, the perception of control is palpable. Indeed, many people prefer driving to flying, believing intuitively that driving, which they control, is safer that flying, which they don't control, even though the statistics plainly show the opposite. Control over a technology need not be complete (one need only think of the thousands of VCRs in America blinking 12:00 day in and day out) but it must be to a degree that users feel confident that they can bend it to their will.

This is the place where computers are the most problematical. They too often seem uncontrollable. There is practically nothing that a user can do with a computer that can cause personal injury (other than perhaps to hit oneself over the head with one, and with the shrinking size of computers even that's no longer particularly effective). Indeed, there isn't all that much one can do with a computer that will damage the computer itself. But due to their sheer internal complexity, computers too often act in mysterious and unpredictable ways. Even the most experienced users daily find themselves asking "Why did it do that?"

Users have been asking computer designers to make them simpler to use for at least the past 20 years, but the designers have given us faster, more powerful machines with ever more powerful (and more complex) facilities. Every useful computer occasionally does something strange. For now, users have to accept this if they want to use the technology. But even this is hardly unprecedented. When was the last time you owned a car that never made a strange noise?

TECHNOPHOBIA AND COMPUTERS

Technophobia exists, despite its failure to be recognized by lexicographers. How do we overcome it? Here are the two things I find most useful.

Understand Why You Want To Use A Computer.

If you are in academia you probably understand why a computer might be useful to you whether you admit it yet or not. Three motivating factors might be:

1. You do any kind of writing that is ultimately typewritten. (By the way, if you already know how to type, you already know a lot of what's needed to use a computer.)
2. You correspond with or would like to correspond with oth-

ers in your field. The Internet is a terrific place to meet people from all of the globe.

3. You do research of any kind. The Internet connects you to libraries, databases, and people all over the world.

For example, using the World Wide Web, *Le WebLouvre* offers a French medieval art demonstration, a collection of well-known paintings from famous artists, and a tour around Paris including the Eiffel Tower and the Champs-Elysees. The tour includes two options—walking around on your own or a historical guided tour with comments. Or, check out NASA's *Astrophysics Data System's Einstein Archive Service*. This service provides query and retrieval capability for the Einstein X-ray Observatory's processed data archive, which includes about 5,000 X-ray observations (in the FITS format used for all astronomical analysis) taken between 1978 and 1981.

The Internet is something you really have to experience to begin to fathom its possibilities. If you haven't checked it out, you are not up to date in your field.

Find Someone To Teach You

None of us learned to drive from a book. Computers aren't a great deal more difficult to use than cars are, but they aren't any easier. It takes a few days to learn the rudiments of driving, and a few weeks or months to become skillful enough for every day driving. Learning to use a computer is about the same amount of work.

I don't know what makes us think that we're suppose to know it all already, but the most useful thing you can do for yourself is find a friend who has a computer or knows about computers, or take a course for people who don't know about computers. If you want to encourage students, you might experiment with buddy systems.

THE INTERNET AS USEFUL, CONTROLLABLE TOOL

Computers still aren't all that familiar except to the youngest and most enthusiastic of their users. But they can certainly be useful and controllable to anyone in academia. We'll go on a short tour.

Electronic Mail

The earliest, most ubiquitous, and for many, the most useful Internet service remains electronic mail. E-mail allows you to send a message that you type on your screen to someone else. This may not sound like much of an improvement over traditional paper mail until you consider that E-mail is usually delivered in under a minute, even to correspondents on other continents. This means that E-mail has much of the immediacy of a telephone call without the intrusiveness. (It also doesn't hurt the popularity of E-mail that messages are usually delivered at no charge beyond the fixed cost of the computer hookup, no matter how far away your correspondents are or how many messages you send.) This means that it's often possible to have a running exchange of E-mail over a few hours or a day, allowing more time for thought than a phone call does but without losing one's train of thought as happens when messages are separated by hours or days. E-mail is considerably easier to answer than is conventional paper mail. As I have told audiences of older people, "The best thing about E-mail is that when you write you grandchildren, they write back."

E-mail also allows people to create electronic *mailing lists*. When you join one of these lists, you receive all of the messages that other members send to the list, and all of the other members receive the messages you send to it. In this way, members of the list can have a running conversation with not just two people participating, but dozens, hundreds, and in a few cases thousands. There are thousands of different lists currently active. Each list has a topic, with topics ranging from the technical (particular kinds of computer equipment, for example) to the specialized (dairy farm management) to the socially relevant (implications of modern technology to personal privacy) to the utterly silly (bad puns found around the Internet). Most lists send out contributions immediately, while some high-volume lists collect each day's message into a daily newsletter.

One of the most remarkable things about Internet mailing lists is that they are for the most part totally informal, both in content and in management. Creating a mailing list takes only a minute's effort by the list's maintainer, after which people anywhere in the world can join and participate.

One-way mailing lists (a single sender and many recipients) are also used to publish everything from daily weather reports and TV program schedules to a newsletter of patent-related news and a weekly humor column written by a computer journalist near Boston. This is self-publishing at its most elemental, with the authors and readers directly connected with no intervening editors and publishers.

So how hard is it to get going with E-mail? Assuming you have some basic typing skills and that someone has set up the necessary programs on a computer you can use, it is not particularly hard. I have taught some people how to use E-mail in as little as 15 minutes, others in an hour or two. What people do need, though, is the motivation—to believe that it is worth their effort to learn to correspond with certain people, whether it be a loved one who has moved to a distant continent or a mailing list of one's professional peers.

Usenet Network News

Usenet is in many ways a parallel to electronic mail, except that rather than sending a message to a particular recipient, you're sending it to anyone who's interested. It's sort of an electronic analog to the notice board at school, but instead of your notice appearing in a single place, it's quickly (a few hours or days) copied to notice boards on tens of thousands of computers with hundreds of thousands of potential readers around the world. To make some sense of the enormous flood of messages that appear on Usenet (something like 50,000 messages a day) the messages are divided up into several thousand topic groups, and each individual user only reads the messages in a handful of groups that are of personal interest. Like with mailing lists, there is a huge range of topics: from literature (different topics cover anything from ancient manuscripts to romance novels to *Star Trek*) to pharmacology (theoretical and applied) to various kinds of computer software, to home beer brewing. Given the volume of messages, there's a lot of noise on Usenet, but there can also be access to an impressive range of expertise, freely volunteered by the participants.

So, again, how difficult is it to get going on Usenet? About the same as E-mail. Indeed, the steps involved in writing a Usenet message are nearly the same as writing an E-mail message. Once a user understands one, he or she can learn the other in a few minutes. But, again, nobody figures out Usenet until he believes that there's something there that will repay the effort involved.

CONCLUSION

Technophobia is an undue fear of things technical. People primarily fear a technology because it appears unfamiliar, uncontrollable, and not useful. To the extent that these three factors are addressed, people come to accept, and frequently to embrace technologies that they formerly feared.

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TECHNOPHOBIA: COUNTERPOINT

By Thomas E. Duston

Before charging full tilt onto the information superhighway, pause for reflection, says the author. Beware, because a small percent of the population, in love with technology, is trying to diffuse their computer culture to the rest of us. What do these computer fans ignore? The extra work computers and other technologies have created, safety and health concerns, loss of control over medical and personnel records, the monitoring of electronic mail, and the waste of office resources, argues the author.

Culture: The concepts, habits, skills, arts, instruments, institutions, etc., of a given people in a given period.

Cultural diffusion: The spread of a cultural trait or pattern from its point of origin to other areas.

Webster's New World Dictionary

INTRODUCTION

In 1994, I attended an NEA conference focused on technology in higher education (*The New Learning Environment: Serving Diversity Through Technology*, Albuquerque, New Mexico, April 8-10, 1994). One of the sessions had the somewhat ominous title, "Technophobia on Campus." Moderated by a self-confessed computer semi-illiterate, the panel consisted of the co-authors of books written specifically for individuals suffering from technophobia—the fear of technology. This apparently is an illness for the '90s. The authors claimed that the books were selling well. I assume a number of buyers not only think technophobia is a significant problem, perhaps even believing that they, a co-worker, or a superviser suffer from the illness and need the help of such a book. The presentation and subsequent discussion about the coming golden age of the information superhighway generated in this listener several disturbing observations about this third or fourth (or whatever) age of computers. This article contains some of my concerns and/or assertions, listed in the order in which they came to me, first during the presentation and then upon continuing reflection.

I appreciate the value of such past and current computer applications as data storage and retrieval, inventory control, scheduling, and billing. My concerns center on three fairly recent trends in computer distribution and use:

- The widespread distribution of home and office personal computers.
- The decentralization of clerical and secretarial tasks, so that many people in businesses, government, educational, and medical institutions now do their own secretarial and clerical tasks.
- The connecting of individuals and institutions through the information superhighway.

This essay is not meant to be an exhaustive list of concerns nor a tightly crafted exercise in scientific discourse. I hope that it will make you simply pause for reflection before charging full tilt onto the information superhighway.

THE VISION OF AN "INFORMATION SUPERHIGHWAY"

The vision of an "information superhighway" is primarily based on the strong interest of a relatively small number of people (5 to 10 percent of the population?) who have taken their personal interest in computer applications and converted it into a desirable (even required) social objective for the rest of us. They have, in other words, created a "computer culture" and are trying to "diffuse" it (see *Webster*).

How have they done this? I suspect that most of us—myself included—have made, however casually, a cost-benefit calculation and rejected a fair portion of the wide range of computer technologies available for our home activities, recreation, and work.

This does not mean that we see no useful functions for such things as personal computers. Those of us who write a lot have come to see the value to a word processor. Some use a computer at work for inventory control, record keeping, or word processing, and certain of these functions seem to meet reasonable cost-benefit tests.

Our friends and colleagues who find personal fulfillment by integrating their home and work with a wider range of computer-related activities cannot understand the hesitation by the rest of us. Their lack of understanding leads them to one or more of the following explanations:

- We suffer from technophobia. Their prescription for this affliction is to write books for us to read, run conference sessions on the subject, and generally treat us as people who will get over this fear if we are patted on the head in the correct way.
- If they can just harass us enough, we will see the light. At least once a week I am told in some context—whether balancing my checkbook, drawing a graph with a ruler, or calling someone on the phone—that I could do it "much easier" if I would just "do it with the computer."
- Computerization is so obviously simple and the right way to go that requiring us to use a computer to do certain tasks—get our mail, register students, receive responses to inquiries—is okay. And it is not necessary to have group discussions or employee input on whether it is appropriate or not.

BOTTLENECKS ON THE INFORMATION SUPERHIGHWAY

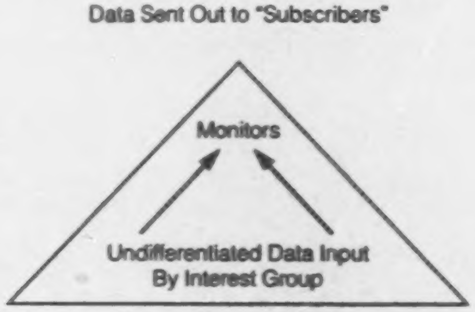
In the near future we will be overwhelmed with undifferentiated information from the superhighway. The information overload will have one or more of these consequences:

- It will cause significant bottlenecks in doing productive work.
- It will be ignored by everyone and represent an incredible waste of resources.
- It will be used in a random way, leading to tremendous irregularities in usefully generated output.

In our current system, we have well-structured systems for screening information prior to its end use. For better or worse there are newspaper editors, professional journal referees, and even the time limitations of television to screen out information that is wrong, inadequate or excessive.

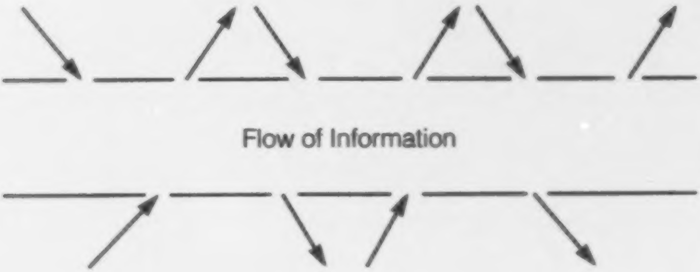
How will we screen information on Internet? I asked one of the panelists this question, and he said that "selected individuals" in *interest groups* will receive the words of everyone who wants to say something on a particular subject and pass along that which is "useful." He said it would be like a pyramid. I have taken the liberty of drawing a picture of his idea (see Figure 1).

Figure 1: Information Monitoring on the Superhighway



But there are at least two basic problems with this view of dealing with undifferentiated information. The first has to do with picturing the flow of information. To me, a more realistic picture of the information super-highway is Figure 2 below. On a superhighway, masses of information will be entering and leaving at many different points. It will be difficult to maintain an interest group input like that shown as the base of the triangle in Figure 1. After all, the cross-referencing potential is so enormous that attempts to establish interest groups will be overwhelmed by related information. A second problem with the monitoring triangle has to do with the role of the "monitor." It seems a much more arbitrary screening device than our current system of editors, referees, and TV producers! Yet information control is a source of great power.

Figure 2: Alternative View of Information Flow
On the Superhighway



EXTRA PRODUCTIVITY OR EXTRA WORK?

The uncritical expansion of computer applications, based on the enthusiasm of those of the computer culture and the indifference of the rest of us, generates extra work for many. This is not a problem to the people in the computer culture because they are already good at this stuff (since they usually have long-term exposure), and they like to do it in any case! The enthusiasm of the computer people is picked up by decision-makers, some of whom are also computer people, and those of us in the disinterested or non-enthusiastic world are stuck with a bunch of extra work rather than less: endless messages on our machines, demands by students, co-workers, and supervisors based on their access to our computers through local E-mail, the frustration of decoding the language of "the culture."

COMPUTER STUFF IS "FUN" AND "SEDUCTIVE"

These words are not mine. They are borrowed from the presenters at the conference. There is no question that one can be seduced—at least temporarily, even for the disinterested—by the first message on E-mail from a friend in Dallas, or by the first graph from the numbers you punched in, or by the first color graphics you see, or even by the swimming fish on the "screen saver." And it can be fun. I use my kids' $39 spell-checker to search the 90,000 entries in *Webster's Dictionary*.

The most fun I had with a computer was back in 1970. As a graduate student at Brown University, I was assigned the task of adapting the BIO-MED regression program so that it would run two-stage least squares without having to print out the computer cards which had to be re-fed for the second stage. Fun? Sure it was. Seductive? Definitely. Worth the hundreds of hours it took? Probably not.

One of the presenters talked glowingly about reading a novel from her computer screen. The safety issue aside, does this make sense? Whatever happened to curling up in front of the fire, or lying in bed, or reading on the beach? How about the safety issue and all that extra time in front of the screen? Listening to recorded books on the tape deck while commuting makes a lot more sense as a way to read a novel if you don't have the time to go to the beach, doze off in bed after the first sentence, or want to enter the high-tech world with your novel reading. Seductive is seductive and fun is fun, but they don't have much to do with productivity and shouldn't be used as even partial justification for expending billions of dollars and person-hours to get us all on the information superhighway.

HOW ABOUT THE SAFETY ISSUE?

In our uncritical acceptance of a future with a computer screen in every room, we seem to have swept under the rug the various and serious problems, continuously raised, related to electromagnetic radiation and various other problems with computer screen watching. Eyestrain, stress, an increase in carpal tunnel syndrome, pregnancy problems, and even cancer have been associated with this technology and its power delivery systems. Since we are now all exposed, instead of just a few struggling office workers, does that make it okay, just another of our daily environmental insults?

I personally would rather *not* heed the call of the late William Loeb (former editor of the *Manchester* (NH) *Union Leader*) who asked us to have "technological courage" and back off on our concerns about the technology of nuclear waste disposal. I would rather use as a standard for technology one I observed some years back at the annual meeting of the American Public Health Association. In a report summarizing hundreds of studies on possible side effects from sonograms, *no evidence was found which could raise any credible doubts in the scientific community.* I would want to start with that as a standard and very reluctantly move away from it.

Instead we are just plunging forward with nothing more than a few brief guidelines as to exposure time in front of computer screens, and no guidelines related to laser printers, fax machines, copiers, and other electronic office equipment. The few existing guidelines do not consider the patterns of computer use and in any case will be irrelevant given the amount of computer time the future will require of us to drive on the superhighway.

HOW DIFFICULT IS THIS STUFF ANYWAY?

Economists like to talk about marginal costs and marginal benefits. In the process of becoming "computer literate," we should be asking what types of training activities generate benefits which exceed their costs and which don't. I don't know the answer to this training question, but we ought to be asking it.

I will make one related observation that I bet is not in books about getting on the information superhighway. Of all the functions one might train for on a computer, the one which seems almost universally worth the effort is simple word processing. And of all the training skills needed for this, the most important is typing!

Here we have what is arguably the *single* most useful skill in the computer age of the future, and I learned it in high school in 1957! I suppose those in the computer culture who write books about various computer skills would refute this. If it takes a whole book to teach someone about E-mail, DOS, or spreadsheets, then those must be very complex skills. Others of the computer culture (my friends and colleagues, for example) claim they can teach you this stuff in 15 minutes!

CONTROL AND POWER

The comments above about excess work and the screening of information are certainly issues of power and control. If the employer is able to increase the workload of the employee through technological innovation without the employee's input, then this is an issue of power and control. In many cases the employer, driven by the "computer culture," may not even perceive the extra work required of the employee. In situations where the employer desires to use the technology to increase control over the employees, the possibilities are endless:

- Information *storage* is now practically costless, so there is a tendency to store every tidbit of information in an employee's file. When the file is later accessed, it may not be known which information is irrelevant and which is important.

- The more networks there are, the more personal medical records are at risk. Employee protection gained after long collective bargaining or legislative struggles may be lost or obsolete.
- Personnel files are also at risk. Information can be added or deleted without an individual's knowledge. A unique problem is that of multiple records in several computers or in different memories of one computer. Appropriate changes are made in one computer location but not in others. At a later time, one of the incorrect files is pulled up and could be used to the detriment of the employee. All of us have run into this problem while dealing with the labyrinth of billing sites which is the US medical care system!
- A very recent problem is that of monitoring the E-mail of individual employees. Monitoring of old-fashioned letters in sealed envelopes presents logistical problems. With electronic mail it is much more difficult for a person to know that his or her mail is "tapped."

Easier access to employee medical records, non-differentiated storage of personnel information, changing or deleting personnel files, monitoring E-mail and identifying the correspondents or "bulletin boards" used, are just a few of the potential problem areas. Information is about control and power. Therefore we should proceed very slowly.

MODERN OFFICE WASTE

The ultimate question, even if all of the preceding ones have been resolved, is whether this wholehearted incorporation of computer technology is actually worth it. Does all or most of it meet a reasonable cost-benefit test? Perhaps it is useful to discuss the question of waste in the context of an office and its functions.

Faxing. How could anyone object to faxing? It is like a long distance copy machine. You put the document in on a plane over the Atlantic and it prints out on your office fax in Chicago! Sounds great; but how often does the cost of a fax justify its increased cost over a 32 cent stamp, an overnight letter, cutting down on the number of drafts sent back and forth, or waiting until the usefulness of the document has expired! My assertion, based on much personal observation and extensive conversation with friends and colleagues in public and private sector settings, is that the single most common use of a fax is in allowing the individuals preparing documents to put off finishing such writing until the day (or even the hour) that the document is due someplace else. The whole process of preparing a document is probably also started later since faxing allows for last minute "submissions." It is difficult to see how the small number of cost-effective faxes used can balance out what seems like a giant waste associated with this most common of uses.

Laser Printing. My office complex is probably typical. We have a network of computers hooked to a laser printer. Although occasionally letter-quality is needed in our office, nine times out of ten this very expensive piece of equipment is spitting out letter or memo drafts, personal messages from Finland, streams of E-mail from some bulletin board, or any number of other uses for which it is "overqualified" in the extreme! Since a laser printer uses nine times as much power as a dot matrix printer and emits questionable microwaves, it is difficult to justify its widespread use.

Repeated drafting of documents with word processing. Most of us have now moved to the new method of preparing memos, letters, and reports. We used to handwrite a draft, have a secretary type it, make the necessary corrections, and then have a secretary type it in final form.

The new way is to go through repeated drafts *searching for the perfect wording*. This requires a great deal more paper, probably just as much secretarial time, and each draft is likely to be printed out on a laser printer. Not surprisingly, any additional benefits decline rapidly as smaller and smaller changes are made in search of the perfect letter. Small changes use the same amount of secretarial time, computer and printer power, and paper, so the incremental or marginal cost rapidly becomes constant. In a world where additional drafts seem so easy, there is nothing to prevent the actual number of drafts to go to a point way past the optimum number.

Non-overlapping and fluid nature of equipment source and labor functions. How often have you begun a new project requiring a new team of co-workers or perhaps a reorganization of current responsibility, and found yourself confronted by team members with incompatible or awkward computer interfaces? Computer hardware (and to some extent software) is bought at a certain point in time in any organization or subunit. Now the *capabilities* of the people in this unit are fixed, perhaps for several years. They get involved in projects with colleagues from other units, who got their computer capabilities from a different source of funds or at a different time period. And their hardware and/or software may be quite different. As the number of institutions or departments working together increases, the area of computer and functional compatibility may get very small.

The Value of Time. The general view is that computers, with their tremendous speed and storage capability, do many things much faster, and free us up to do other productive things (or new things on the computer). There is no question that the general perception is correct when things are going right. But how about the time wasted when the problems alluded to above are encountered? How about training time as new software is continuously introduced? How about when you place a phone call and have to go through multiples of whole bunches of push-button options to finally get put on hold? How about phone message machines at work that allow other people to make requests of you overnight, forcing you to squeeze your responses in on top of your normal workday?

As a college professor, my message machine allows students to contact me at their leisure. I have to listen to all the messages because ones of importance may be imbedded. But I still have to run the same number of office hours for face-to-face business!

One model of the classroom of the future has an electronic blackboard with each student having a receptor personal computer. The notes on the board go right on the student's screen. The faculty can call up and place all kinds of extra material on the student's screen. Sounds like a lot of extra work to me. How is this different from a carefully chosen textbook? Sounds like a lot of extra work for the teacher.

Comparative Advantage. The principle of comparative advantage occupies an exalted spot in microeconomic theory. Put in simple terms and applied to the workplace, comparative advantage means that society gets the greatest possible output of goods and services as people specialize and do those tasks where they have the greatest skill advantage or the least skill disadvantage, relative to some other person who might do that task. Perhaps I have a small advantage over Joe if we were both trying for a store clerk's job but a large advantage if we both wanted to be college professors. Since I can't do both, I specialize in being a college professor, Joe specializes in being a store clerk, and the *total output* from the two of us is maximized. The ways in which various types of technology interfere with this principle are fairly obvious. In the previous section we noticed how a multiple-option, multiple-layer phone answering machine shifted the task of correctly distributing phone calls from an individual trained in the skill to me and a machine. It is often very frustrating for the caller to figure out the correct option or options for the routing of his or her phone calls. Half the time it seems that "Hold the line for an operator" is the best option. Is this efficient? A very familiar example is that of document preparation for those of us who are used to having someone working with us who possesses highly developed secretarial and clerical skills. Now with word processing and electronic mail, we awkwardly type our own materials, usually filled with formatting mistakes, while large numbers of skilled secretarial workers end up as store clerks. The fact that I type and my former secretary "clerks" leads to reduced total output for society. Technology has led us to violate the principle of comparative advantage.

TOLLGATES, DETOURS, AND ROADBLOCKS ALONG THE INFORMATION SUPERHIGHWAY

Will everyone get on the information superhighway? Does it matter? Will this be one of those control things coming a bit later than Orwell predicted? What will determine who gets on and who doesn't? If the reader has been willing to accept a fair portion of the arguments presented in the first eight sections of this article, then it should be pretty obvious who will get on the highway and avoid the detours, roadblocks, and tollgates. It is the people who are in the forefront of the computer culture who will have the resources and the interest to keep cruising along. The rest of us will either lack the resources to pay initial hardware toll, the interest to find ways around the detours put up by new software requirements, or the occupational flexibility or personal time to deal with the various roadblocks of equipment maintenance, obsolescence, or equipment incompatibility. In other words, those of the computer culture will define what they do as the "information superhighway," it will be sold by them as the important place to be, and the rest of us will hang on or fall off while letting them decide the patterns of work, education, and recreation for the future.

CONTRIBUTORS

Albert Gore, inaugurated as the 45th Vice President of the United States on January 20, 1993, was raised in Carthage, Tennessee and Washington, D.C. He received a degree in government with honors from Harvard University in 1969, later attending Vanderbilt University Divinity School and Vanderbilt Law School. Gore's Congressional career began when he was elected to the U.S. House of Representatives in 1976. He was elected to the U.S. Senate in 1984 and was reelected in 1990. During his eight years in the House and eight years as a Senator, Vice President Gore became a nationally recognized leader in the areas of science, space, and technology policy. He continues his leadership role in these areas as Vice President. He is a leader in the development of the National Information Infrastructure (NII).

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Technology and Higher Education

The notion that technology will be a dominant factor in the growth and development of higher education in the next century generates diverse responses. Some see great opportunities in a technology-rich future, while others focus on the great challenges. Can we enhance student learning and explore the most innovative uses of new technologies? Who will decide the rights and responsibilities of faculty, staff, and students as technology transforms the academy? When it comes to intellectual property, "who owns what"?

By answering these questions and raising many others, this volume will be of interest to many audiences. Policy makers considering budget allocations and campus policy statements will find insight and strategies for making good use of limited resources. Faculty and staff will get a better understanding of how their working conditions are evolving and aid for their efforts to make the best uses of technology in their classrooms, labs, and offices. Administrators will find ideas that help them promote student learning, improve employee morale, and encourage creative uses of technology on campus.

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